

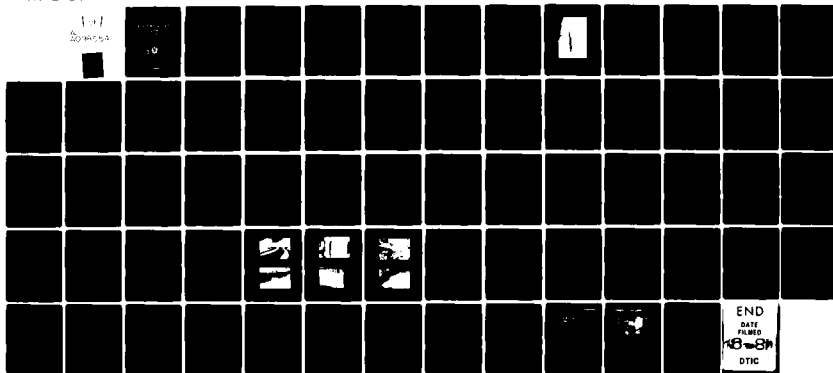
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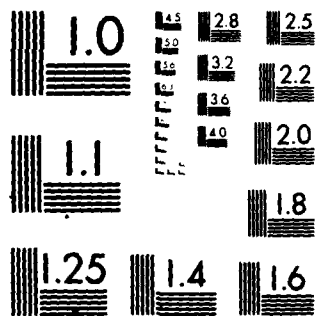
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CAMDEN COUNTY  
NEW JERSEY

LEVEL

National Dam Safety Program.

**BLACKWOOD LAKE.**

**DAM**

**(NJ 00800).**

Delaware River Basin, South Branch Timber Creek,  
Camden County, New Jersey.

**PHASE 1 INSPECTION REPORT.**

**NATIONAL DAM SAFETY PROGRAM**

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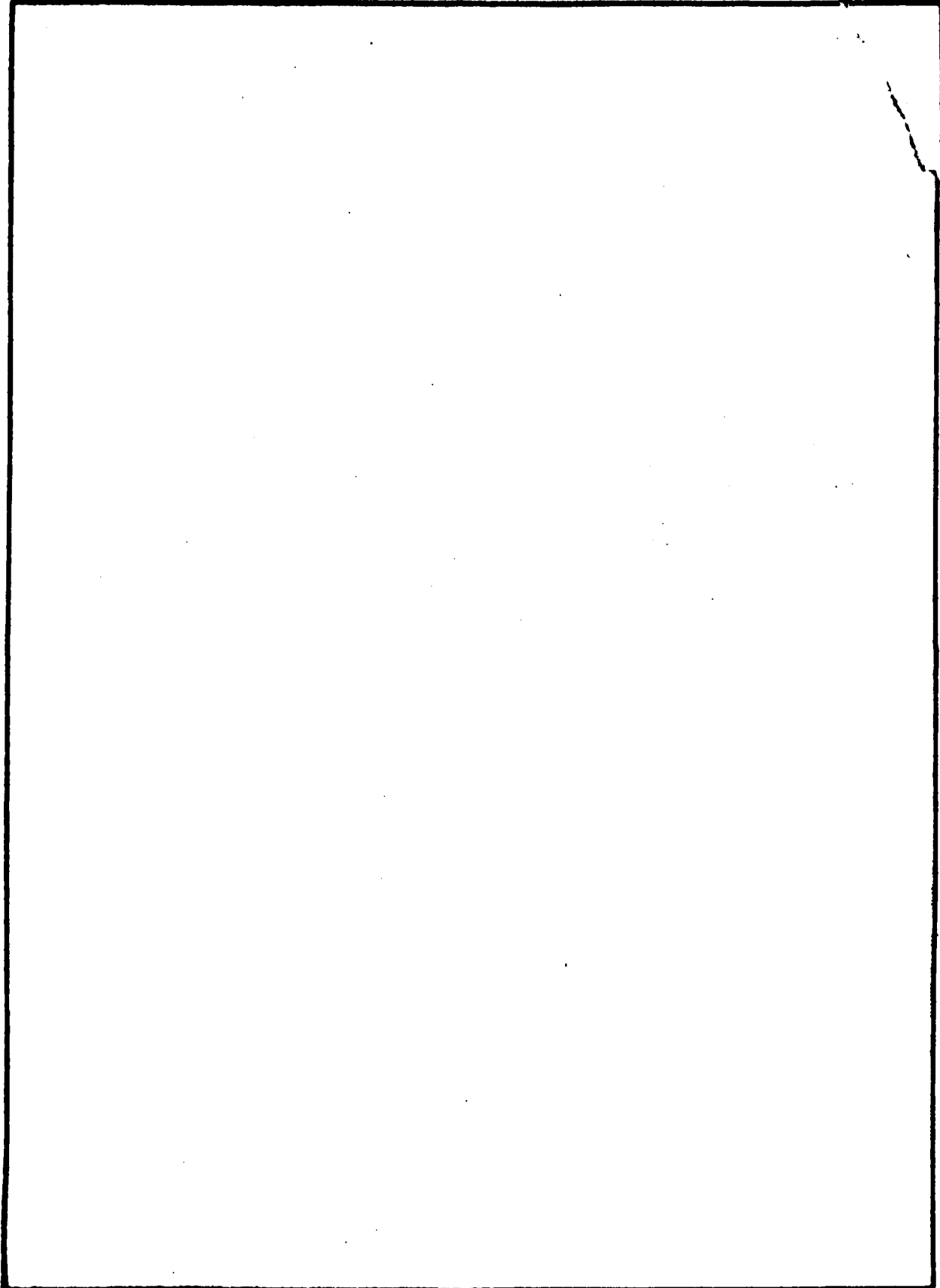
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|---|--|---|
| 1. REPORT NUMBER  | 2. GOVT ACCESSION NO.  | 3. RECIPIENT'S CATALOG NUMBER               |
| DAEN/NAP-53842/NJ00800-81/03 v  | AD-A098 554  |   |
| 4. TITLE (and Subtitle)   | 5. TYPE OF REPORT & PERIOD COVERED                             |   |
| Phase I Inspection Report<br>National Dam Safety Program<br>Blackwood Lake Dam, NJ00800<br>Camden County, NJ  | FINAL  |   |
| 7. AUTHOR(s)  | 6. PERFORMING ORG. REPORT NUMBER                               |   |
| Abraham Perera, P.E.  |  |   |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS   | 8. CONTRACT OR GRANT NUMBER(s)                                 |   |
| Louis Berger & Associates<br>100 Halstead St.<br>East Orange, N.J. 07019  | DACW61-79-C-0011   |   |
| 11. CONTROLLING OFFICE NAME AND ADDRESS   | 10. PROGRAM ELEMENT, PROJECT, TASK<br>AREA & WORK UNIT NUMBERS |   |
| NJ Department of Environmental Protection<br>Division of Water Resources<br>P.O. Box CNO29<br>Trenton, NJ 08625   |  |   |
| 14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)   | 12. REPORT DATE  |   |
| U.S. Army Engineer District, Philadelphia<br>Custom House, 2d & Chestnut Streets<br>Philadelphia, PA 19106  | March, 1981  |   |
|   | 13. NUMBER OF PAGES  |   |
|   | 40   |   |
|   | 15. SECURITY CLASS. (of this report)                           |   |
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|   | 15a. DECLASSIFICATION/DOWNGRADING<br>SCHEDULE                  |   |
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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)   |  |   |
| This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report. |  |   |

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Honorable Brendan T. Byrne  
Governor of New Jersey  
Trenton, New Jersey 08621

28 APR 1981

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Blackwood Lake Dam in Camden County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Blackwood Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 68 percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from the date of approval of this report the following remedial actions should be initiated:

(1) The downstream slopes of the dam embankment in the vicinity of the bridge wingwalls should be regraded, compacted, and topped with suitable slope paving. The channel banks immediately downstream should be protected with stone riprap.

(2) The immediate downstream channel bottom should be filled in with heavy stone to prevent continual scouring and preclude the undermining of the bridge structures.

(3) The spalled and deteriorated concrete surfaces of the bridge should be patched and the masonry of the wingwalls on the downstream side be repaired.

NAPEN-M

Honorable Brendan T. Byrne

(4) The owners should develop a plan, in cooperation with the South Jersey Gas Company, to either relocate the gas mains away from the spillway channel or adequately protect them against rupture during overtopping of the dam.

c. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

d. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Florio of the First District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for time to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer

1 Incl  
As stated

**Copies furnished:**

Mr. Dirk C. Hofman, P.E., Deputy Director  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief  
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Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

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BLACKWOOD LAKE DAM (NJ00800)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 3 September 1980 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Blackwood Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 68 percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from the date of approval of this report the following remedial actions should be initiated:

(1) The downstream slopes of the dam embankment in the vicinity of the bridge wingwalls should be regraded, compacted, and topped with suitable slope paving. The channel banks immediately downstream should be protected with stone riprap.

(2) The immediate downstream channel bottom should be filled in with heavy stone to prevent continual scouring and preclude the undermining of the bridge structures.


(3) The spalled and deteriorated concrete surfaces of the bridge should be patched and the masonry of the wingwalls on the downstream side be repaired.

(4) The owners should develop a plan, in cooperation with the New Jersey Gas Company, to either relocate the gas mains away from the spillway channel or adequately protect them against rupture during overtopping of the dam.

c. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

d. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

APPROVED:

  
JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer

DATE:

21 Apr 1981



PHASE I REPORT  
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Blackwood Lake Dam Fed ID# NJ 00800 and  
NJ ID# 384

State Located New Jersey  
Counties Located Gloucester/Camden  
Coordinates Lat. 3948.1 - Long. 7504.4  
Stream South Branch Timber Creek

ASSESSMENT OF  
GENERAL CONDITIONS

Blackwood Lake Dam is considered to be in a fair overall structural condition. While an overtopping of the highway extending along the centerline of the dam would probably not result in loss of life, it could cause appreciable damage to downstream utilities. Accordingly, it is recommended that the dam be downgraded from high to the significant hazard category. No detrimental findings were uncovered that would lead to questions about the dam's structural stability. Remedial actions recommended to be undertaken in the future are 1) regrade and protect the downstream embankment areas at the bridge wingwalls, 2) place riprap in the downstream channel, 3) patch the concrete and masonry surfaces of the bridge substructure, and 4) relocate the gas mains out of spillway channel or protect them against rupture during severe storms. The sluiceway under the bridge is inadequate since it can accommodate only 67% of the 100-year design flood. In view of the hazard classification, further hydraulic studies are recommended and the owner should develop written operating and maintenance procedures as well as an emergency action plan and downstream warning system.

  
Abraham Perera P.E.  
Project Manager



OVERVIEW OF BLACKWOOD LAKE DAM  
AUGUST, 1980

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## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines can be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I investigations is to identify expeditiously those dams that may pose hazards to human life or property. The assessment of the general condition of the dam is based on available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In the review of this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway test flood is based on the estimated "probable maximum flood" for the region (greatest reasonable possible storm runoff) or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: BLACKWOOD LAKE DAM FED ID# NJ 00800

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The state, in turn, is under agreement with the U.S. Army Engineer District, Philadelphia, to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Blackwood Lake Dam and appurtenant structures and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Blackwood Lake Dam is a 58-year-old local road embankment approximately 200 feet long that contains a concrete slab bridge under which there is a three-celled sluiceway. The embankment carries Blackwood Road across the north end of the lake. The embankment is approximately 12 feet high near the bridge abutments and tapers in height as it progresses toward the east and west banks of the lake. The three-celled sluiceway walls constitute the two abutments and the two middle piers of the bridge. The outside cells are 7 feet wide and are closed by means of 4 foot by 6 foot stop logs wedged between steel channels embedded in concrete. The center cell is 6 feet wide and is U-shaped. It was formerly closed by a concrete

wall at the downstream end. Only the edges of this wall remain at the present time. The sluiceway is 22 feet wide on the upstream side and 22.5 feet wide on the downstream side. The roadway embankment constituting the dam is 48 feet wide at the roadway level and has approximate slopes of 2.0H:1.0V. The left upstream side of the embankment is retained behind the southwest wingwall of the bridge. The wingwall is 72 feet long. Against this wingwall is attached a graduated rod that serves as a water level gauge. Through the same wingwall passes a concrete flume that connects with a pump house on the downstream side of the dam. The flume gate appears inoperable.

b. Location

Blackwood Lake Dam is located 0.4 miles west of the intersection of Blackwood Road and Black Horse Pike. The dam is built across the South Branch of Big Timber Creek, which constitutes the boundary between the Gloucester and Camden counties. Blackwood Lake Dam is on the boundary of Gloucester Township in Camden County and Washington Township in Gloucester County.

c. Size Classification

The maximum height of the dam is 11.2 feet at the bridge structure and the maximum storage is estimated to be 462 acre-feet. Therefore, the dam is placed in the small size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

While a failure could cause substantial property damage to the pump house near the downstream slope of the dam, to the utility lines on the dam itself, and to the Blenheim Sewage Treatment Plant located approximately 0.5 miles downstream from the dam, no loss of human life would result. Accordingly, it is recommended that the hazard classification of this dam be downgraded to significant. All dwellings on either side of the downstream channel or near the dam are above the flood elevation. Approximately 0.8 miles downstream, the flood plain widens considerably and is basically undeveloped.

e. Ownership

As best as could be determined, the ownership of the road and bridge structure that forms the dam is shared by the Boards of Chosen Freeholders of both Camden and Gloucester counties. The county dividing line passes through the center of the spillway bridge, and the dam embankment is a municipal street, thereby implying some form of joint ownership. The original dam was constructed with financing from the two townships and the two counties involved. The responsibility for the maintenance and operation of the dam, as per a letter of the New Jersey Department of Conservation and Economic Development dated June 11, 1968 and addressed to Camden and Gloucester counties Boards of Chosen Freeholders, appears to lie with the Blackwood Lake Improvement Association, an association of lake shore property owners. A 1968 title search by the Gloucester County Office of the County Engineer seems to have discovered that the Blackwood Lake belonged to a Davis Estate. It was not clear whether part or all of the dam was on the property of the Davis Estate.

f. Purpose of Dam

The dam presently impounds a recreation lake. However, a water supply pump house exists near the left (east) abutment and is the property of the Garden State Water Company. The pump house is located on the downstream side just a few yards east of the left (east) abutment of the bridge. As reported in an inspection report in March of 1942, the pumps of the pump house were driven by a water wheel. Thus, the former purpose of the dam may have been both water supply and power generation.

g. Design and Construction History

The original Blackwood Lake Dam and spillway were built in 1922. No information was located concerning the hydraulic/hydrologic criteria upon which the design of the original dam was based. The dam was reconstructed in 1942 following its collapse during the September 1940 flood during which several upstream dams were also overtopped and destroyed. The 1940 flood records indicate

that the embankment was overtopped by 4.5 feet of water and that the dam failed because of a wash-out of the downstream embankment slopes.

In 1942 plans were prepared for substantial modifications to the dam and Application No. 384 was filed for their construction on April 16, 1942. The modifications included a 75-foot-long circular spillway upstream from the bridge, designed to accommodate a maximum discharge of 1,770 cubic feet per second. These modifications were never constructed, however. New gates were installed in the spillway in 1947. These gates are mentioned in an article that appeared in the Philadelphia Bulletin on August 17, 1967. Several articles that appeared in the local New Jersey newspapers in August 1967 describe the damage done by the flood that year when, once more, the dam was overtopped (see Appendix). In order to reduce the probability of the dam's overtopping in the future, the Camden County Engineer had prepared in July 1967 a plan for modifications of the sluiceways consisting of a reduction in the height of the stop logs and the removal of the concrete wall obstructing the downstream end of the center sluiceway cell. In order to construct these modifications, after prolonged discussions, the lake level was lowered in late 1968. The modifications were constructed, presumably shortly after the lake was lowered. In a letter from the Blackwood Water Company to the Camden County Engineer, dated March 17, 1969, a serious leak through the dam embankment was mentioned. This leak had presumably occurred after the lake was raised to its new level (as per modified sluice gates). Although there is no record of it, the leak must have been subsequently repaired. No records were located that would indicate any further overtoppings, damage, or any repairs or modifications to the Blackwood Lake Dam after 1969.

h. Normal Operating Procedures

No information could be obtained relating to operating procedures except for the removal of stop logs in the sluiceways and the lowering of the lake level in the past.



### 1.3 PERTINENT DATA

a. Drainage Area

The drainage area of Blackwood Lake Dam is 19.1 square miles.

b. Discharge of Dam Site

The spillway capacity at maximum pool elevation is 1,764 cfs.

c. Elevation (above MSL)

Top of dam - 21.8 (bridge deck or roadway)  
Recreation pool - + 11.8  
Streambed at center line of dam - + 9.3

d. Reservoir

Length of maximum pool - 6,000 feet  
Length of recreation pool - 3,500 feet

e. Storage

Top of dam - 462 acre-feet  
Recreation pool - 54 acre-feet

f. Reservoir Surface

Top of dam - 90.6 acres  
Recreation pool - 18.0 acres

g. Dam

Type - earth embankment with 3-celled concrete  
sluiceway  
Length - 200 feet  
Maximum structural height - 14 $\pm$  feet (concrete  
bridge structure)  
Effective height at spillway - 2.5 feet (top of  
stop logs)  
Freeboard between normal reservoir and top of  
dam - 10 feet  
Top width - 48 feet  
Side slopes - 2H:1V U/S, 2H:1V D/S  
Zoning - composition and compactness unknown

h. Diversion and Regulating Tunnel

None - inoperable flume

i. Spillway

Type - 3-celled concrete sluiceway  
Length of weir - 20 feet (total 3 cells)  
Crest elevation - +11.8

J. Regulating Outlets

Stop logs in outer cells of the 3-celled  
sluiceway

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

The only information available for review were partially legible drawings of the proposed reconstructed bridge and dam prepared in 1942 by the W.P.A., and the 1967 drawing for the modification of the sluiceways prepared by the Camden County Engineer. No design or construction drawings were located for the bridge or dam construction or repairs prior to 1967. The plans prepared by W.P.A. in 1942 contain details pertaining to a large portion of the original 1922 construction. This was further supplemented by measurements done during the field inspection.

### 2.2 CONSTRUCTION

No information was available on the construction of the original dam except for the fact that it was done by the Kolyn Construction Company and John Albertson, Contractor.

### 2.3 OPERATION

See Section 4.

### 2.4 EVALUATION

#### a. Availability

In view of the dam assessment and recommendations contained in Section 7, it is felt that sufficient engineering data are available to not require obtaining additional design data on the original contract plans.

#### b. Adequacy

In view of the dam assessment and recommendations contained in Section 7, it is felt the field inspection provided adequate engineering data upon which to base a reliable assessment.

#### c. Validity

The validity of the 1942 and 1967 plans is not challenged.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

#### a. General

The visual inspection was conducted on September 3, 1980, at which time the water level in the lake was producing a moderate flow over the three-celled sluiceway (which prevented close inspection of the timber stop logs). The overall physical condition of the dam is fair, but the embankment slopes are very poorly graded, especially at the bridge downstream wingwalls.

#### b. Dam

The roadway embankment, which forms the main dam structure, was assessed to be in a solid and stable condition, although pavement runoff at the gutter lines causes a continual drainage problem, especially on the downstream side. The crest of the dam is an asphalt-paved two-lane road. A considerable portion of the downstream sideslopes adjacent to the wingwalls has been heavily eroded, particularly on the left. This may be due to a combination of poorly compacted fill that was replaced after the flood of 1967 and the erosion from roadway runoff. On the downstream side, the effective length of the embankment is considerably shorter than on the upstream side because of adjacent ground filling due to the construction of a residence on the right and the Blackwood Water Company pump house on the left.

#### c. Appurtenant Structures

The concrete bridge that carries the Blackwood Road traffic over the spillway is in fair condition. It is a unique three-celled culvert formed by the abutments and the two piers supporting the bridge deck. The steel beams used for the support of the formwork used to construct the bridge deck are still visible on the downstream side and are heavily rusted and corroded. Two utility mains cross the bridge opening and are supported either on the sluiceway walls or on the downstream wingwalls. They are the gas mains of the South Jersey Gas Company. They, together with the steel beams mentioned above, effectively encroach on the clear opening under the bridge

and could be damaged if there were a flood. The dam supports the poles of the aerial lines of the main cable of the New Jersey Bell Telephone Company and the power line of the Public Service Electric & Gas Company. These lines would also be endangered in case of overtopping. The concrete of the upstream face of the bridge exhibits heavy spalling in several places. The concrete surfaces of the sluiceway are eroded and the aggregate is exposed. The downstream sidewall shows a sizeable joint separation. The downstream portion of the bridge abutments and the downstream wingwalls are constructed of stone masonry. This masonry is eroded in several places and shows joint cracks. The upstream bridge parapets that extend to the upstream left wingwall constitute an effective barrier to flow during overtopping and would cause, in such an event, additional rise in the water level.

d. Reservoir

Blackwood Lake has stable wooded banks, but there is little evidence of maintenance. Immediately adjacent to the dam, the reservoir shows heavy vegetative growth, indicating silting and shallow depth.

e. Downstream Channel

The downstream channel is reasonably well-defined and flows through a basically undeveloped area except for the residence adjacent to the right bank. This residence is well above the flood level, however. Further downstream is the Blenheim Sewage Treatment Plant, which is located on low terrain adjacent to the channel and could suffer heavy damage if the channel were overtopped.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

Operational procedures were not observed by the inspection team. The present owner of the lake appears to have only maintenance responsibility. No operational procedures exist except those undertaken in the past (such as the dewatering of the lake in 1968).

### 4.2 MAINTENANCE OF DAM

Maintenance of the roadway and bridge is carried out as part of the maintenance program for the road system. There is apparently little or no continual maintenance of the sluiceway under the bridge.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

There are no workable operating facilities except for the stop logs that were installed in the two side sluiceway cells.

### 4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

There is no formalized warning system in effect. The dam is positioned on the county boundary line, which may be the cause of possible jurisdictional misunderstanding.

### 4.5 EVALUATION OF OPERATIONAL ADEQUACY

No overtopping of the dam has been recorded since 1967. Although the structure appears to operate satisfactorily even though it is essentially unattended, the ownership responsibility for periodic maintenance and a warning system should be clarified in the future by responsible authorities.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

#### a. Design Data

In accordance with the criteria in the Recommended Guidelines for Safety Inspection of Dams, it has been determined that the dam at Blackwood Lake is small in size and of significant hazard. Accordingly, the Spillway Design Flood (SDF) was determined by the inspection team to be a 1 in 100-year storm. The inflow hydrograph was calculated using precipitation data from Technical Paper No. 40. The inflow hydrograph and flood routing were performed utilizing the HEC-1 Dam Break version computer program. Peak inflow to the reservoir for the 1 in 100-year storm was 2,934 cfs and, when routed, was reduced insignificantly to 2,627 cfs. The spillway capacity before overtopping occurs is calculated to be 1,764 cfs. Therefore, the spillway will accommodate 67% of the SDF. This flood would cause the dam to be overtopped by approximately .9 feet.

#### b. Experience Data

Records indicate that the dam has been overtopped and failed in the past (see Paragraph 1.2 g.). The September 1940 flood caused the failure of the dam by washing out the embankment on the right of the spillway and partially undermining the embankment on the left. High water marks indicated that the flood passed over the road at a depth of about 4.5 feet (approximately equivalent to one-half of the probable maximum flood-PMF) and that the maximum high water level beyond the dam was about 2.5 feet lower.

#### c. Visual Observations

The concrete sluiceway under the bridge appears to be functioning adequately under the normal flows except for the siltation just upstream of the stop logs. At the time of inspection, the water level was 4 inches above the top of the stop logs and above the concrete floor of the center U-shaped cells. The gauge attached to the bridge's upstream wingwall indicates an elevation

of 2 feet 5 inches from the adjacent bottom. It can be assumed that the zero of the gauge is at the reservoir bottom. The gauge therefore serves only to indicate the depth of water in the reservoir.

d. Overtopping Potential

Based on the results of the hydraulic analysis, the capacity of the spillway is inadequate to accommodate the SDF. The dam has been overtopped at least twice in the past, and the hydraulic review indicates that the potential for overtopping continues to exist. However, property damage or hazardous conditions are likely to occur only downstream, and no loss of life would be expected. (None is recorded during the failure of 1940 and overtopping of 1967.)

e. Drawdown Potential

At the present time, the only facilities available to draw down the lake are the stop logs, which would have to be removed to effect the drawdown. If the logs are removed, it would take approximately 15.5 hours to draw down to elevation 9.25.



## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

#### a. Visual Observations

The bridge structure and the concrete of the sluiceway are in overall fair condition and their structural stability is considered adequate. Based on available records, the bridge is founded on hard pan that is overlain by hard sandy clay. However, due to the constructed sluiceway changes beneath the deck, the excessive exit velocities could gradually scour out the discharge channel and eventually endanger the stability of the downstream wingwalls, which already show evidence of past scouring. The dam embankment is judged to be in a satisfactory and stable condition, as it is excessively wide compared to its height and is protected on the left upstream side by the long bridge wingwall.

#### b. Design and Construction Data

As no design data relating to the concrete bridge were available, little can be deduced relative to the bridge's structural stability except that it exhibits only minor surface spalling and some joint separation at the sidewalk. The concrete spillway, although hydraulically inadequate, appears to be conservatively designed structurally and is therefore judged to be in an adequate structural condition.

#### c. Operating Records

No formal operating records exist. As previously stated, the dam appears to have operated satisfactorily under normal flows as there does not appear to be any record of the roadway being overtopped since 1967.

#### d. Post Construction Changes

There have been no changes to the hydraulic elements of the dam since 1968. The dam appears today, with the exception of the removal of the downstream concrete wall blocking the center cell of the sluiceway under the bridge, essentially as it existed in 1942.

e. Seismic Stability

The bridge appears to have an adequate factor of safety against static loadings, and experience indicates that it will therefore have adequate stability against Zone 1 dynamic loadings. The height of the embankment is sufficiently low to be only negligibly vulnerable to any type of loading.

## SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT

#### a. Safety

Subject to the inherent limitations of the Phase I visual inspection, the Blackwood Lake Dam is classified as being in a sound and overall fair condition. This assessment applies also to the concrete bridge and the sluiceway below its deck. No seriously detrimental findings were uncovered in this inspection that would lead to questions about the dam's structural stability. The concrete sluiceway under the bridge is inadequate hydraulically, being able to accommodate only 27% of the 1/2 PMF design flood. The overtopping potential is considerable because of the hydraulically substandard spillway crest width and the ease with which the narrow sluiceway openings under the bridge can be blocked with debris. There is little that can be done to increase the present spillway capacity without undertaking major reconstruction. However, as there is a potential for heavy damage to utility lines at the dam and the sewage treatment plant downstream but only a slight potential for the loss of human life should the dam collapse, is recommended that the hazard category be downgraded to significant.

#### b. Adequacy of Information

The information gathered for the Phase I inspection is deemed to be adequate regarding the structural stability of the dam except for the lack of detailed information regarding the bridge foundations. No surveys or inspections have been recorded since 1974, and the dam has undergone deterioration since that time.

#### c. Urgency

The remedial measures set forth below should be performed in the near future.

d. Necessity for Further Studies

Since the dam spillway can accommodate only a small percentage of the SDF, and in view of the hazard classification, it is recommended that additional, more precise hydraulic studies be made in the near future.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

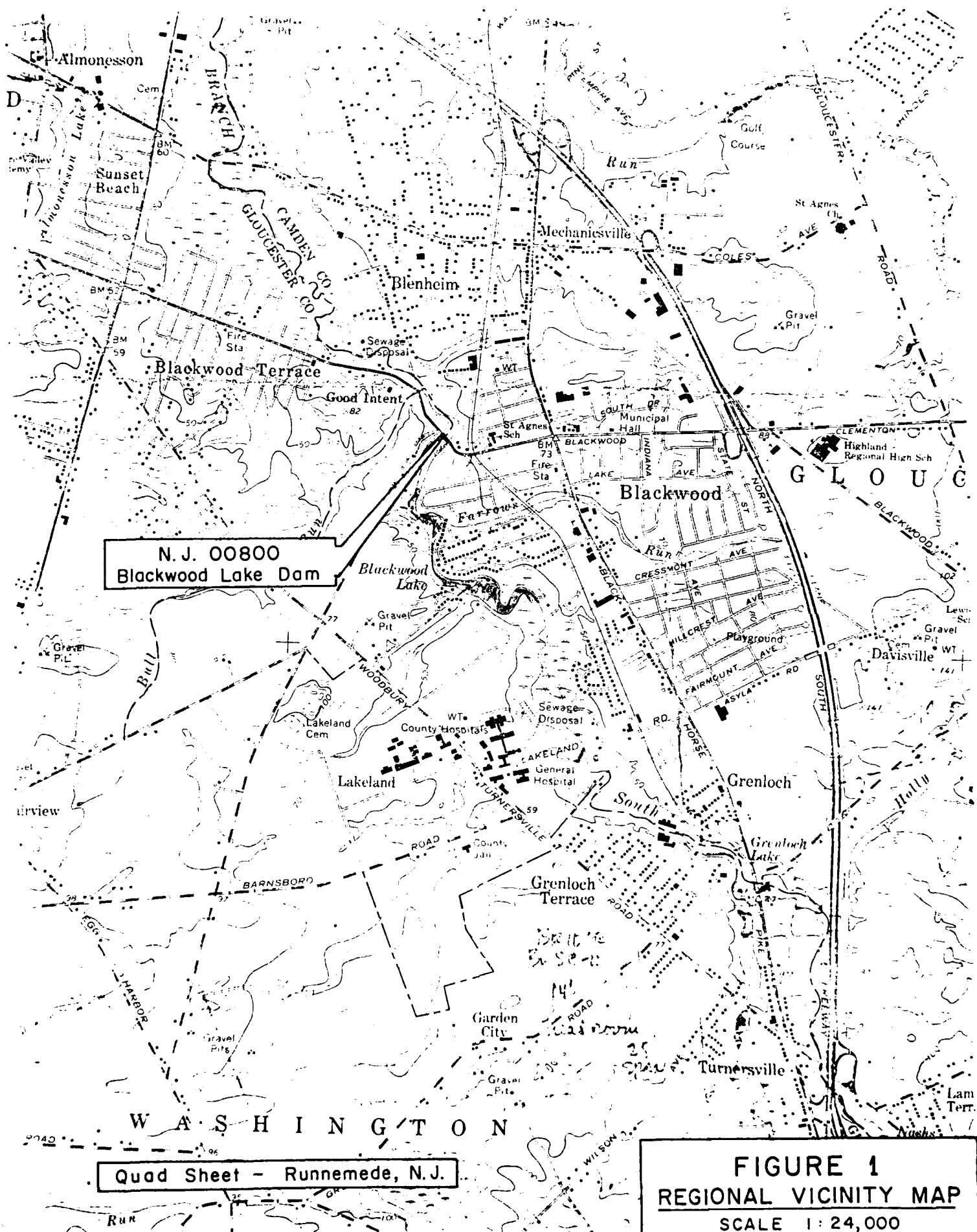
It is recommended that the ownership and responsibility for maintenance be clarified so that the recommended remedial work and O&M procedures can be implemented without legal ambiguities.

a. Recommendations

- (1) The downstream slopes of the dam embankment in the vicinity of the bridge wingwalls should be regraded, compacted, and topped with suitable slope paving. The channel banks immediately downstream should be protected with stone riprap.
- (2) The immediate downstream channel bottom should be filled in with heavy stone to prevent continual scouring and preclude the undermining of the bridge structure.
- (3) The spalled and deteriorated concrete surfaces of the bridge should be patched and the masonry of the wingwalls on the downstream side be repaired.
- (4) The owners should develop a plan, in cooperation with the South Jersey Gas Company, to either relocate the gas mains away from the spillway channel or adequately protect them against rupture during overtopping of the dam.

b. O&M Maintenance and Procedures

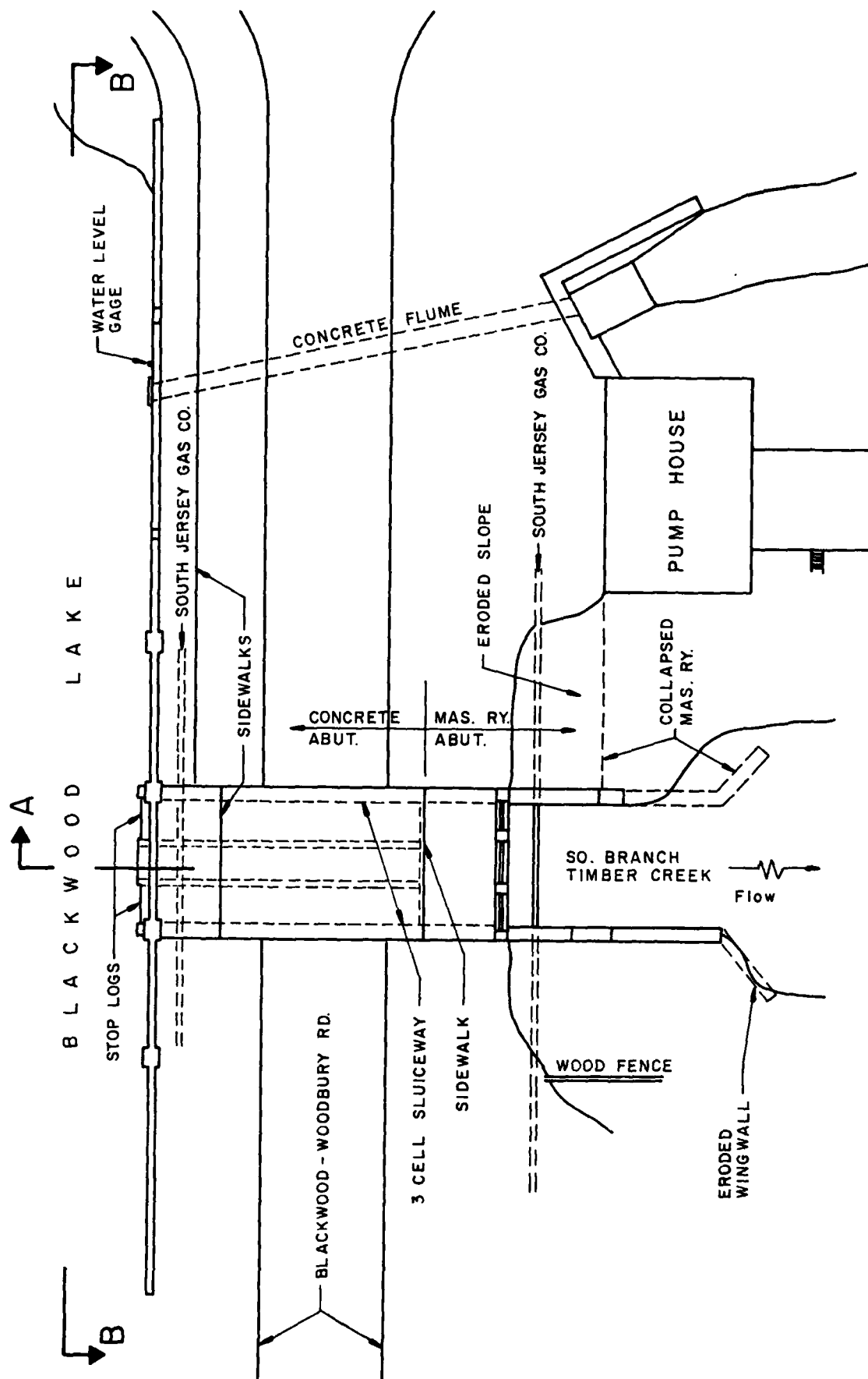
In the near future, the owners should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam. The owners should also develop an emergency action plan and a downstream warning system to minimize the potential for damage during severe storms.



N.J. 00800  
Blackwood Lake Dam

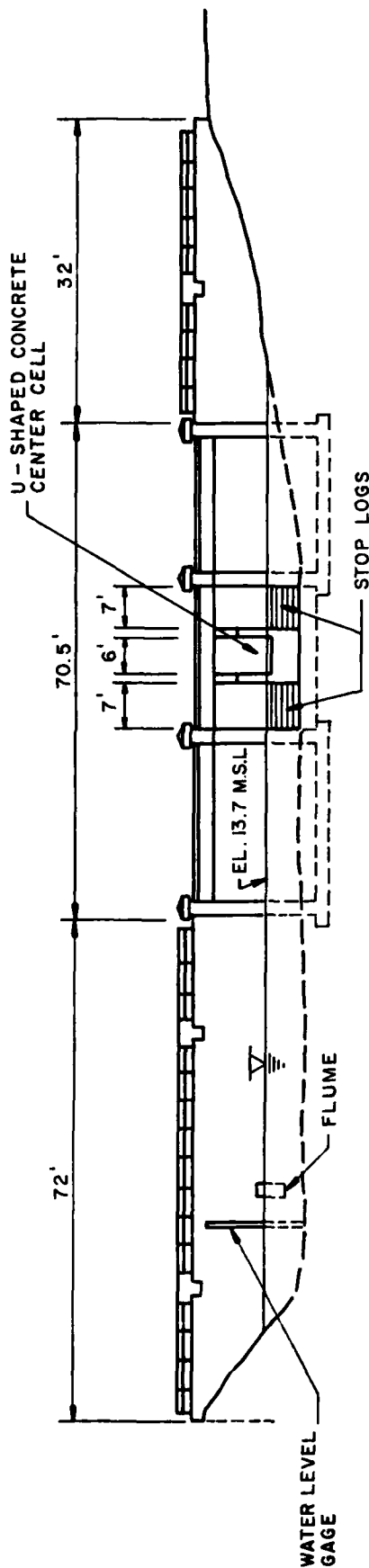
Quad Sheet - Runnemede, N.J.

FIGURE 1  
REGIONAL VICINITY MAP  
SCALE 1" = 24,000'



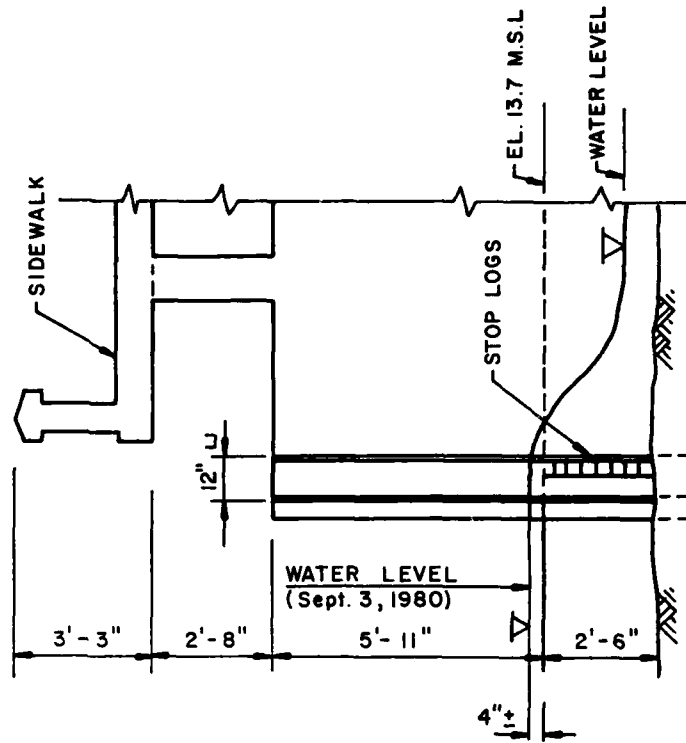
PLAN

FIGURE 2



**ELEVATION B-B**

NOT TO SCALE



**SECTION A  
SLUICeway**

Check List  
Visual Inspection  
Phase I

Name Dam Blackwood Lake Dam County Gloucester/Camden State New Jersey Coordinators N.J.D.E.P.

Date(s) Inspection 9/3/80 Weather Sunny Temperature 90°F

Pool Elevation at Time of Inspection + 14 M.S.L. Tailwater at Time of Inspection + 10+ M.S.L.

Inspection Personnel:

|                   |                      |
|-------------------|----------------------|
| <u>A. Perera</u>  | <u>J. Greenstein</u> |
| <u>D. Lang</u>    | <u></u>              |
| <u>T. Chapter</u> | <u></u>              |

A. Perera Recorder



# CONCRETE/MASONRY DAMS

| VISUAL EXAMINATION OF                            | OBSERVATIONS                     | REMARKS OR RECOMMENDATIONS |
|--|----------------------------------|----------------------------|
| SEEPAGE OR LEAKAGE                               |                                  |                            |
| STRUCTURE TO<br>ABUTMENT/EMBANKMENT<br>JUNCTIONS | Satisfactory                     |                            |
| DRAINS   | None                             |                            |
| WATER PASSAGES                                   | None                             |                            |
| FOUNDATION                                       | Compact sandy clay over hard pan |                            |

# CONCRETE/MASONRY DAMS

| VISUAL EXAMINATION OF                | OBSERVATIONS   | REMARKS OR RECOMMENDATIONS |
|--------------------------------------|--|----------------------------|
| SURFACE CRACKS<br>CONCRETE SURFACES  |  |                            |
| STRUCTURAL CRACKING                  | Spalling of concrete bridge surfaces                               |                            |
| VERTICAL AND HORIZONTAL<br>ALIGNMENT | Satisfactory - dam is roadway embankment                           |                            |
| MONOLITH JOINTS                      | Satisfactory   |                            |
| CONSTRUCTION JOINTS                  | Separation noted on bridge sidewalk longitudinal joints<br><br>iii |                            |

# EMBANKMENT

| VISUAL EXAMINATION OF                                  | OBSERVATIONS  | REMARKS OR RECOMMENDATIONS            |
|--|---|---------------------------------------|
| SURFACE CRACKS   | None Observed   |                                       |
| UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE      | None Observed   |                                       |
| SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES | Severe slope erosion adjacent to downstream left wingwall, minor erosion at right downstream wingwall       | Regrade and protect with stone riprap |
| VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST         | Satisfactory - dam is roadway embankment  |                                       |
| RIPRAP FAILURES  | Northwest downstream side of bridge, large chunks of collapsed masonry wall lying on embankment slope<br>iv | Repair and/or regrade                 |

12

EMBANKMENT

| VISUAL EXAMINATION OF                                       | OBSERVATIONS   | REMARKS OR RECOMMENDATIONS |
|---|--|----------------------------|
| JUNCTION OF EMBANKMENT<br>AND ABUTMENT, SPILLWAY<br>AND DAM | Satisfactory - road embankment asphalt paved<br>road (two lanes) |                            |
| ANY NOTICEABLE SEEPAGE                                      | None Observed  |                            |
| STAFF GAGE AND RECORDER                                     | None   |                            |
| DRAINS  | None   |                            |

# OUTLET WORKS

| VISUAL EXAMINATION OF  | OBSERVATIONS                         | REMARKS OR RECOMMENDATIONS |
|--|--------------------------------------|----------------------------|
| CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT | Surfaces eroded - aggregate exposed  |                            |
| INTAKE STRUCTURE   | See concrete weir section            |                            |
| OUTLET STRUCTURE   | Concrete wall removed in center cell |                            |
| OUTLET CHANNEL   | See downstream channel section       |                            |
| EMERGENCY GATE   | None                                 |                            |

# UNGATED SPILLWAY

| VISUAL EXAMINATION OF | OBSERVATIONS  | REMARKS OR RECOMMENDATIONS |
|-----------------------|---|----------------------------|
| CONCRETE WEIR         | <p>3-celled concrete sluiceway</p> <p>Outside cells: 7 ft. wide with 6" x 6" timber stop logs</p> <p>Center Cell: U-shaped, 6 ft. wide</p>  |                            |
| APPROACH CHANNEL      | <p>None - Blackwood Lake directly upstream of dam and 3-celled concrete sluiceway</p>   |                            |
| DISCHARGE CHANNEL     | <p>Natural channel approximately 30 feet wide, slopes approximately 2H:1V.</p>  |                            |
| BRIDGE AND PIERS      | <p>Satisfactory overall condition</p> <p>Abutments: downstream portion is masonry, upstream is concrete</p> <p>Two Piers: Concrete with top 2 ft., 8 inches made of six - 12" x 12" columns supporting the bridge deck.</p> |                            |

## GATED SPILLWAY

| VISUAL EXAMINATION OF         | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|-------------------------------|--------------|----------------------------|
| CONCRETE SILL                 | N/A          |                            |
| APPROACH CHANNEL              | N/A          |                            |
| DISCHARGE CHANNEL             | N/A          |                            |
| BRIDGE AND PIERS              | N/A          |                            |
| GATES AND OPERATION EQUIPMENT | N/A          |                            |

# INSTRUMENTATION

| VISUAL EXAMINATION    | OBSERVATIONS                            | REMARKS OR RECOMMENDATIONS |
|-----------------------|---|----------------------------|
| MONUMENTATION/SURVEYS | None                                    |                            |
| OBSERVATION WELLS     | None                                    |                            |
| WEIRS                 | None                                    |                            |
| PIEZOMETERS           | None                                    |                            |
| OTHER                 | Pump house left of downstream end<br>ix |                            |



# RESERVOIR

| VISUAL EXAMINATION OF | OBSERVATIONS  | REMARKS OR RECOMMENDATIONS |
|-----------------------|---|----------------------------|
| SLOPES                | 1 : 1 banks heavily wooded  |                            |
| SEDIMENTATION         | Many shallow spots next to the dam and along banks. Vegetative growth showing above water |                            |
|                       |   |                            |
|                       |   |                            |
|                       |   |                            |

DOWNSTREAM CHANNEL

| VISUAL EXAMINATION OF                         | OBSERVATIONS   | REMARKS OR RECOMMENDATIONS   |
|---|--|--|
| CONDITION<br>(OBSTRUCTIONS,<br>DEBRIS, ETC.)  | Some debris but generally clear and swift moving flow.   |  |
| SLOPES  | Approximately 2H:1V approximately 8 feet high just below bridge then rapidly diminishing in height. Large trees and brush on each side.  |  |
| APPROXIMATE NO.<br>OF HOMES AND<br>POPULATION | One residence on right bank close to the bridge but located well above flood levels. Pump house on left. Sewage treatment plant, approx. 3000' d/s from dam. South Jersey Gas Co. has 2 mains, one under bridge deck and the other on downstream wingwalls, both encroaching on d/s spillway channel. Main cable of N.J. Bell telephone Co. and electric lines on poles located in top of dam. | Gas main encroaching in the spillway channel should be either relocated or protected against rupture during severe storms. |
|   |  |  |
|   | xi   |  |

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION

| ITEM  | REMARKS  |
|---|--|
| PLAN OF DAM   | Available (1942 Dwg.)<br>NJ DEP Microfilm, P.O. Box 2809, Trenton N.J. |
| REGIONAL VICINITY MAP                                       | Available (from U.S.G.S. quad)   |
| CONSTRUCTION HISTORY  | Reasonably well documented   |
| TYPICAL SECTIONS OF DAM                                     | Available  |
| HYDROLOGIC/HYDRAULIC DATA                                   | Some Available   |
| OUTLETS - PLAN<br>- DETAILS<br>- CONSTRAINTS<br>- DISCHARGE | Available<br>Available<br>None Available<br>None Available             |
| RAINFALL/RESERVOIR RECORDS                                  | None Available   |

| ITEM                                   | REMARKS   |
|--|-----------|
| SPILLWAY PLAN                          |           |
| SECTIONS                               | Available |
| DETAILS                                | Available |
| OPERATING EQUIPMENT<br>PLANS & DETAILS | Available |
|  | N/A       |

| ITEM  | REMARKS  |
|---|--|
| DESIGN REPORTS  | None Available   |
| GEOLOGY REPORTS   | None Available   |
| DESIGN COMPUTATIONS<br>HYDROLOGY & HYDRAULICS<br>DAM STABILITY<br>SEEPAGE STUDIES | None Available<br>Some Available<br>None Available<br>None Available |
| MATERIALS INVESTIGATIONS<br>BORING RECORDS<br>LABORATORY<br>FIELD                 | None Available<br>None Available<br>None Available<br>None Available |
| POST-CONSTRUCTION SURVEYS OF DAM  | None Available   |
| BORROW SOURCES.   | Unknown<br>xiv   |

| ITEM  | REMARKS   |
|---|---|
| MONITORING SYSTEMS  | None  |
| MODIFICATIONS   | Some Available - 1967 wall removal (Camden County)<br>Office of the County Engineer<br>2276 43rd Street<br>Pennsauken, N.J. 08110<br>Also, N.J. DEP Microfilm, P.O. Box 2809<br>Trenton, N.J. |
| HIGH POOL RECORDS   | Some Available  |
| POST CONSTRUCTION ENGINEERING<br>STUDIES AND REPORTS        | None Available  |
| PRIOR ACCIDENTS OR FAILURE OF DAM<br>DESCRIPTION<br>REPORTS | Available<br>Available<br>Available   |
| MAINTENANCE<br>OPERATION<br>RECORDS                         | None Available  |



View of Dam Crest

August, 1980

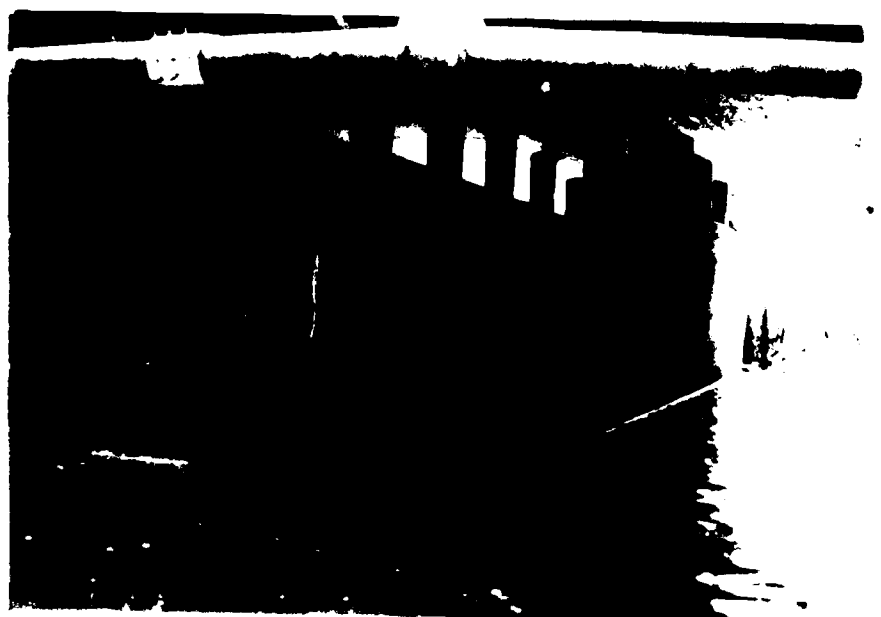


Face of Dam and Staff Gauge

August, 1980



Intake - Spillway Structure August, 1980



Outlet - Spillway Structure August, 1980





August, 1980  
Collapsed Wall - Left Downstream Embankment



August, 1980  
Right Downstream Wingwall

CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 19.1 square miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): +11.8 N.G.V.D. (54 acre - feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: N/A

ELEVATION TOP DAM: 21.8 N.G.V.D. (bridge deck)

CREST: \_\_\_\_\_

- a. Elevation +11.8
- b. Type 3-cell concrete sluiceway \*
- c. Width 6 inches
- d. Length 20 feet ±
- e. Location Spillover under bridge
- f. Number and Type of Gates None

OUTLET WORKS: None

- a. Type \_\_\_\_\_
- b. Location \_\_\_\_\_
- c. Entrance inverts \_\_\_\_\_
- d. Exit inverts \_\_\_\_\_
- e. Emergency draindown facilities (By removal of stop logs) (See Crest)

HYDROMETEOROLOGICAL GAGES: None

- a. Type \_\_\_\_\_
- b. Location \_\_\_\_\_
- c. Records \_\_\_\_\_

MAXIMUM NON-DAMAGING DISCHARGE: 1764 cfs

\* 2 outside cells with stop logs (flashboards)

BY \_\_\_\_\_ DATE \_\_\_\_\_  
CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
SUBJECT \_\_\_\_\_

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 41 OF A15  
PROJECT \_\_\_\_\_

CLARK COEFFICIENTS :

$$\begin{aligned} t_c &= 6.0 \\ R &= 14.0 \end{aligned}$$

} SUPPLIED BY CORPS OF ENGINEERS

DRAINAGE AREA = 19.1 SQ. MILES

BY Genet DATE 4/8/74  
CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
SUBJECT \_\_\_\_\_

LOUIS BERGER & ASSOCIATES INC.

BLICKENSDO LAKE DATA

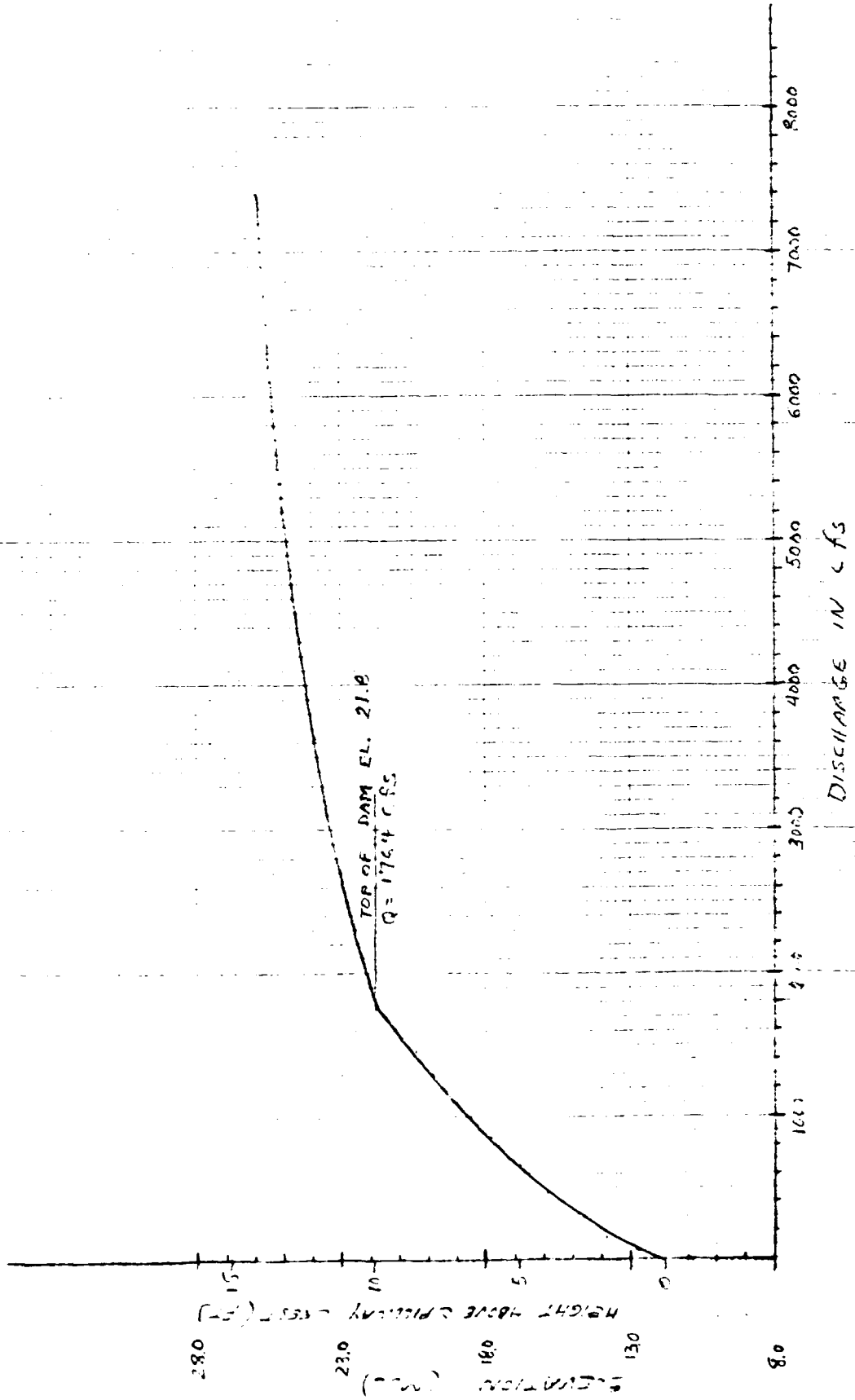
SHEET NO. A2 OF 415  
PROJECT C 262

PRECIPITATION DATA FROM TP-40 C NOAA TECHNICAL  
MEMORANDUM NOS HYDRO-35

| TIME | PRECIPITATION | $\Delta$ | REARRANGED $\Delta$ |   |
|------|---------------|----------|---------------------|---|
| 1.0  | 3.10          | 3.10     | .24                 |   |
| 2.0  | 4.00          | 0.90     | .31                 | 4 |
| 3.0  | 4.4           | 0.40     | .40                 | 3 |
| 4.0  | 4.71          | 0.31     | 3.1                 | 1 |
| 5.0  | 4.96          | 0.25     | .90                 | 2 |
| 6.0  | 5.20          | 0.24     | .25                 | 5 |



BACKWOOD LAKE DAM  
SPILLWAY STAGE DISCHARGE CURVE



BY                      DATE 4/4/81

## LOUIS BERGER &amp; ASSOCIATES INC.

SHEET NO 1-5 OF 1-5CHKD. BY                      DATE                     BUCKWOOD LANE PUMPPROJECT                     SUBJECT                     2.0 IN. 12 IN. CONCRETE STONE DISCHARGE CALCULATION

CONCRETE FLOW  
2 CELLS 7' DIA  
L = 14' D = 11.2'  
USED 40 LBS. CEMENT

WEIR FLOW  
1 CELL 6' FLUME  
L = 6'  
Q = CLH<sup>3/2</sup>

TOTAL Q

(GFS)

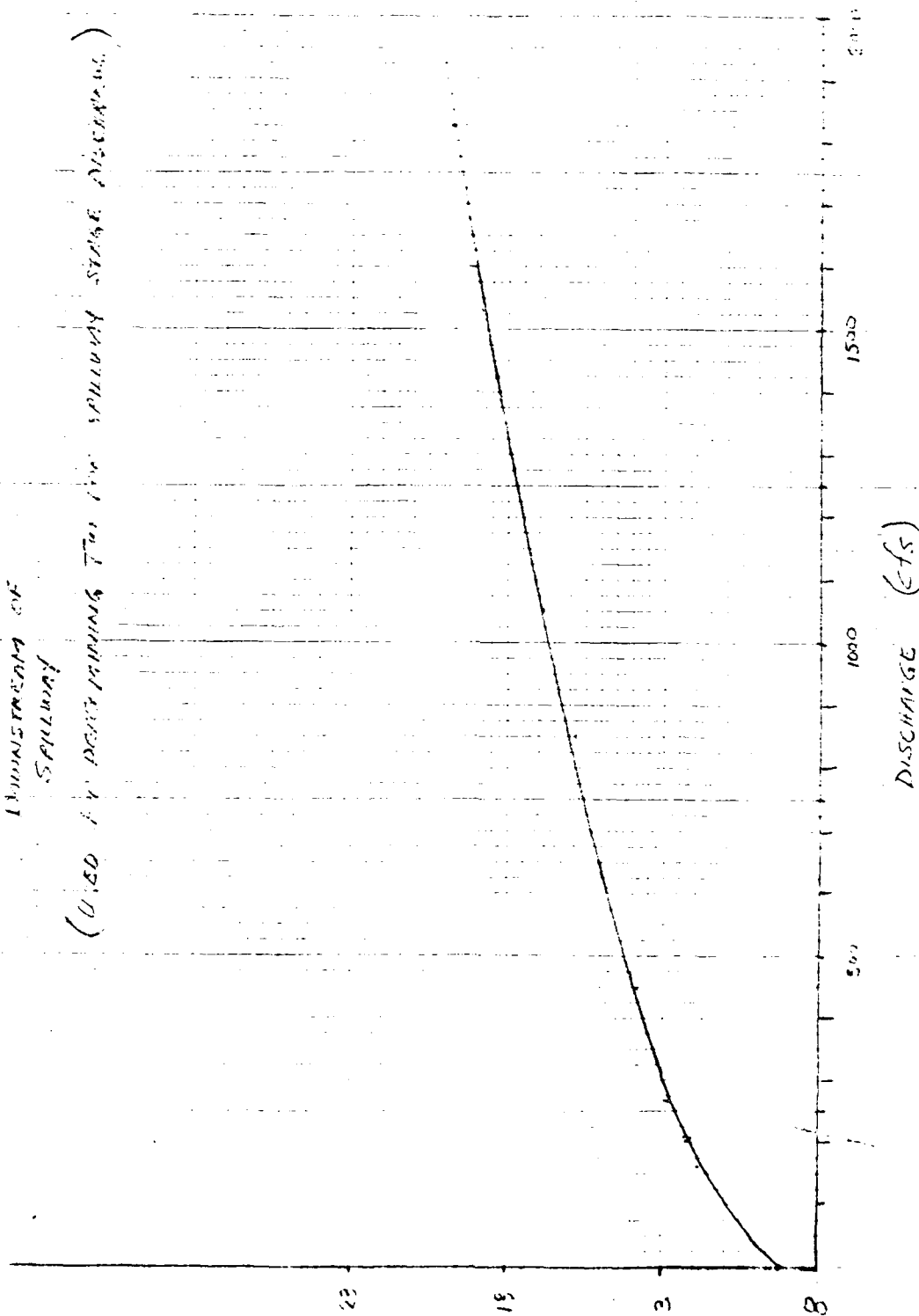
| HEAD | H <sub>1</sub> | Q    | H    | C   | Q   |
|------|----------------|------|------|-----|-----|
| 9.3  | 0              | 0    | -    |     | -   |
| 11.8 | 2.5            | 165  | -    |     | -   |
| 12.3 | 3              | 210  | 0.5  | 3.1 | 7   |
| 12.8 | 3.5            | 252  | 1.0  |     | 19  |
| 13.8 | 4.5            | 392  | 2.0  |     | 53  |
| 14.8 | 5.5            | 518  | 3.0  |     | 96  |
| 15.8 | 6.5            | 700  | 4.0  |     | 149 |
| 16.8 | 7.5            | 840  | 5.0  |     | 208 |
| 17.8 | 8.5            | 1004 | 6.0  |     | 273 |
| 18.3 | 9.0            | 1120 | 6.5  |     | 305 |
| 18.8 | 9.5            | 1190 | 7.0  |     | 344 |
| 19.8 | 10.5           | 1430 | 8.0  |     | 421 |
| 20.4 | 11.2           | 1540 | 8.7  | 1   | 477 |
| 21.4 | 12.5           | 1780 | 10.0 |     | 593 |

(ENTRANCE)

-  
163  
217  
271  
445  
614  
849  
1043  
1277  
1426  
1534  
1821  
2017  
2338

BLACKWOOD LAKE DAM  
STAGE DISCHARGE CURVE  
CONVERTED TO INCHES  
DOWNSTREAM OF  
SAWYER

(USED FOR DETERMINING THE SPILLWAY STAGE DISCHARGE)

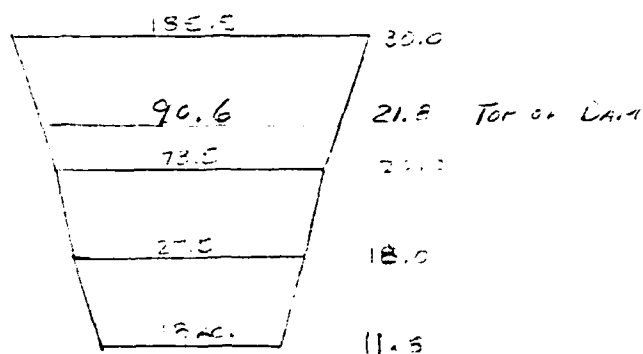


ELEV. IN FT.

DISCHARGE (CFS)



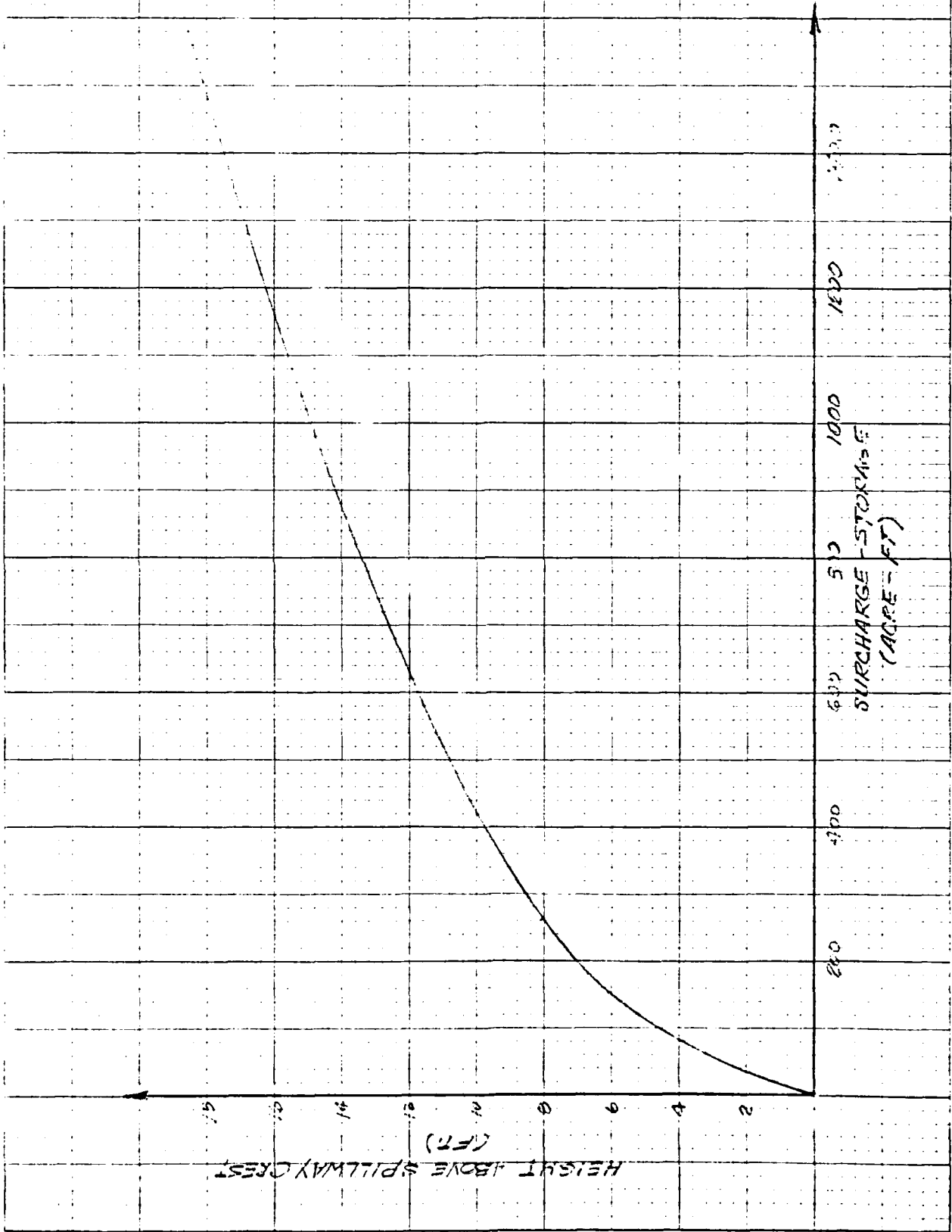
SHEET NO. A7 OF A15  
PROJECT 600



| ELEV. | H    | AREA (ACRES) | SURCHARGE TOTAL - F (AC-F) |
|-------|------|--------------|----------------------------|
| 11.8  | 0    | 18           | 0                          |
| 16.0  | 6.2  | 27.5         | 159                        |
| 20.0  | 8.2  | 73.5         | 260                        |
| 24.8  | 10.0 | 90.6         | 408                        |
| 30.5  | 18.2 | 185.5        | 1540                       |

BLACKWOOD LAKE DAM  
SURCHARGE - STORAGE  
CURVE

AB OF A 15



46 0780

U.S. GEOLOGICAL SURVEY  
WATER RESOURCES DIVISION  
PACIFIC DIVISION  
SAN FRANCISCO, CALIF.

BY J. S. DATE 8/27/67

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 4.9 OF 4.15

CHKD. BY J. S. DATE 4/11/71

BLACKWOOD LAKE DAM

PROJECT 3/2/67

SUBJECT

DRAINAGE CAPACITY

IF ALL FLASHBOARDS ARE REMOVED, LAKE CAN BE LOWERED TO  
ELEV. 11.3 FROM ELEV. 13.8

$$L = 7' + 7' = 14' ; C = 3.0 \quad H_{AVG} = \frac{2.5'}{2} = 1.25$$

$$Q = 3.0 \times 14 \times 1.25^{1.5} = 58 \text{ cfs}$$

ASSUME INFLOW TO BE  $1 \text{ cfs}/\text{mi}^2 \therefore \approx 19 \text{ cfs}$

$$\therefore Q_{OUT} = 58 - 19 = 39 \text{ cfs}$$

VOLUME OF LAKE = 54 ACRE-FT.

ASSUME TOTAL OF 20 ACRE-FT CAN BE DISCHARGED

$$T_{DRAIN} = \frac{20 \text{ AC-FT} \times 43560 \text{ FT}^2/\text{AC}}{39 \text{ FT}^3/\text{SEC} \times 3600 \text{ SEC}/\text{HR}} \approx 15.5 \text{ HOURS}$$

BY Special DATE 4/1/1

## LOUIS BERGER &amp; ASSOCIATES INC.

SHEET NO. 115 OF 115

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

BLACKWOOD LAKES D.A.PROJECT C 342

SUBJECT \_\_\_\_\_

HEC1.DA

|    |     |                                |      |      |       |       |      |      |      |      |   |   |
|----|-----|--------------------------------|------|------|-------|-------|------|------|------|------|---|---|
| 1  | A1  | BLACKWOOD HEC1DB               |      |      |       |       |      |      |      |      |   |   |
| 2  | A2  | J. CERAVOLD                    |      |      |       |       |      |      |      |      |   |   |
| 3  | A3  | APRIL 8 1981                   |      |      |       |       |      |      |      |      |   |   |
| 4  | B   | 150                            | 1    | 0    | 0     | 0     | 0    | 0    | 0    | 0    | 0 | 0 |
| 5  | B1  | 3                              |      |      |       |       |      |      |      |      |   |   |
| 6  | K   | 0                              | 1    |      |       |       |      |      | 1    |      |   |   |
| 7  | K1  | INFLOW HYD                     |      |      |       |       |      |      |      |      |   |   |
| 8  | M   | 0                              | 0    | 19.1 |       |       |      |      |      |      |   |   |
| 9  | O   | 6                              |      |      |       |       |      |      |      |      |   |   |
| 10 | O1  | .24                            | .31  | .40  | 3.1   | .90   | .25  |      |      |      |   |   |
| 11 | T   |                                |      |      |       |       |      | .5   | .1   |      |   |   |
| 12 | V   | 6                              | 14   | 0    |       |       |      |      |      |      |   |   |
| 13 | X   | 0                              | 0    | 1    |       |       |      |      |      |      |   |   |
| 14 | K   | 1                              | 2    |      |       |       |      |      | 1    |      |   |   |
| 15 | K1  | ROUTED FLOWS THROUGH RESERVOIR |      |      |       |       |      |      |      |      |   |   |
| 16 | Y   |                                |      | 1    |       |       |      |      |      |      |   |   |
| 17 | Y1  | 1                              |      |      |       |       |      |      | -1   |      |   |   |
| 18 | Y4  | 11.8                           | 13.8 | 15.8 | 17.8  | 19.8  | 20.8 | 21.8 | 23.8 | 25.8 |   |   |
| 19 | Y5  | 0                              | 175  | 481  | 843   | 1278  | 1450 | 1764 | 3623 | 7399 |   |   |
| 20 | \$A | 18                             | 27.5 | 73.5 | 101.5 | 185.5 |      |      |      |      |   |   |
| 21 | \$E | 11.8                           | 18.0 | 20.0 | 22.5  | 30.0  |      |      |      |      |   |   |
| 22 | \$S | 11.8                           |      |      |       |       |      |      |      |      |   |   |
| 23 | \$D | 21.8                           |      |      |       |       |      |      |      |      |   |   |
| 24 | K   | 99                             |      |      |       |       |      |      |      |      |   |   |

## JOB SPECIFICATION

|     |     |      |       |     |       |       |      |      |       |
|-----|-----|------|-------|-----|-------|-------|------|------|-------|
| NG  | NHR | NMIN | IDAY  | IHR | IMIN  | METRC | IPLT | IPRT | NSTAN |
| 150 | 1   | 0    | 0     | 0   | 0     | 0     | 0    | 0    | 0     |
|     |     |      | JOPER | NWT | LROPT | TRACE |      |      |       |
|     |     |      | 3     | 0   | 0     | 0     |      |      |       |

## INFLOW HYD

|       |       |       |       |      |      |       |        |       |
|-------|-------|-------|-------|------|------|-------|--------|-------|
| ISTAG | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
| 1     | 0     | 0     | 0     | 0    | 0    | 1     | 0      | 0     |

## HYDROGRAPH DATA

|       |      |       |      |       |       |       |       |       |       |
|-------|------|-------|------|-------|-------|-------|-------|-------|-------|
| IHYDG | IUHG | TAREA | SNAP | TRSDA | TRSPC | RATIO | ISNOW | ISAME | LOCAL |
| 0     | 0    | 19.10 | 0.00 | 19.10 | 0.00  | 0.000 | 0     | 0     | 0     |

## PRECIP PATTERN

|      |      |      |      |      |      |  |  |  |  |
|------|------|------|------|------|------|--|--|--|--|
| 0.24 | 0.31 | 0.40 | 3.10 | 0.90 | 0.25 |  |  |  |  |
|------|------|------|------|------|------|--|--|--|--|

## LOSS DATA

|       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| LROPT | STRKR | DLTKR | RTIDL | ERAIN | STRKS | RTIOK | STRTL | CNSTL | ALSMX | RTIMP |
| 0     | 0.00  | 0.00  | 1.00  | 0.00  | 0.00  | 1.00  | 0.50  | 0.10  | 0.00  | 0.00  |

## SUB-AREA RUNOFF COMPUTATION

## PRECIP DATA

|    |       |      |      |
|----|-------|------|------|
| NP | STORM | DAJ  | DAK  |
| 6  | 0.00  | 0.00 | 0.00 |

## UNIT HYDROGRAPH DATA

TC= 6.00 R= 14.00 NTA= 0

## RECESSION DATA

STRTG= 0.00 GRCSN= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH 78 END-OF-PERIOD ORDINATES, LAG= 5.97 HOURS, CP= 0.34 VOL= 1.00

|      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|
| 41.  | 154. | 315. | 486. | 624. | 697. | 690. | 642. | 598. | 557. |
| 518. | 483. | 449. | 418. | 389. | 363. | 338. | 314. | 293. | 272. |
| 254. | 236. | 220. | 205. | 191. | 177. | 165. | 154. | 143. | 133. |
| 124. | 116. | 108. | 100. | 93.  | 87.  | 81.  | 75.  | 70.  | 65.  |
| 61.  | 57.  | 53.  | 49.  | 46.  | 43.  | 40.  | 37.  | 34.  | 32.  |
| 30.  | 28.  | 26.  | 24.  | 22.  | 21.  | 19.  | 18.  | 17.  | 16.  |
| 15.  | 14.  | 13.  | 12.  | 11.  | 10.  | 9.   | 9.   | 8.   | 8.   |
| 7.   | 7.   | 6.   | 6.   | 5.   | 5.   | 5.   | 4.   |      |      |

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

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## HYDROGRAPH ROUTING

|       |      |     |       |       |       |       |        |
|-------|------|-----|-------|-------|-------|-------|--------|
| NSTPS | NSTD | LAG | AMSK  | X     | TSK   | STORA | ISPRAT |
| 1     | 0    | 0   | 0.000 | 0.000 | 0.000 | 0     | -1     |

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

BY J.C. DATE \_\_\_\_\_  
CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
SUBJECT \_\_\_\_\_

# LOUIS BERGER & ASSOCIATES INC.

BRIDGE 1000 L.A.  
HCCI DR

SHEET NO. 411 OF 115  
PROJECT 262

| END-OF-PERIOD FLOW |        |        |      |      |      |        |        |        |        | PERIOD |      | RAIN |        | EXCS   |        | LOSS   |      | COMP G |      |        |
|--------------------|--------|--------|------|------|------|--------|--------|--------|--------|--------|------|------|--------|--------|--------|--------|------|--------|------|--------|
| MO. DA             | HR. MN | PERIOD | RAIN | EXCS | LOSS | COMP G | MO. DA | HR. MN | PERIOD | RAIN   | EXCS | LOSS | COMP G | MO. DA | HR. MN | PERIOD | RAIN | EXCS   | LOSS | COMP G |
| 1 01               | 1 00   | 1      | 0.24 | 0.00 | 0.24 | 0.     | 1 04   | 4 00   | 76     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 2 00   | 2      | 0.31 | 0.03   | 0.28 | 0.27   |
| 1 01               | 2 00   | 2      | 0.31 | 0.03 | 0.28 | 1.     | 1 04   | 5 00   | 77     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 3 00   | 3      | 0.40 | 0.30   | 0.10 | 0.25   |
| 1 01               | 3 00   | 3      | 0.40 | 0.30 | 0.10 | 17.    | 1 04   | 6 00   | 78     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 4 00   | 4      | 3.10 | 3.00   | 0.10 | 0.23   |
| 1 01               | 4 00   | 4      | 3.10 | 3.00 | 0.10 | 179.   | 1 04   | 7 00   | 79     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 5 00   | 5      | 0.90 | 0.80   | 0.10 | 0.22   |
| 1 01               | 5 00   | 5      | 0.90 | 0.80 | 0.10 | 605.   | 1 04   | 8 00   | 80     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 6 00   | 6      | 0.25 | 0.15   | 0.10 | 0.20   |
| 1 01               | 6 00   | 6      | 0.25 | 0.15 | 0.10 | 1240.  | 1 04   | 9 00   | 81     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 7 00   | 7      | 0.00 | 0.00   | 0.00 | 0.17   |
| 1 01               | 7 00   | 7      | 0.00 | 0.00 | 0.00 | 1945.  | 1 04   | 10 00  | 82     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 8 00   | 8      | 0.00 | 0.00   | 0.00 | 0.14   |
| 1 01               | 8 00   | 8      | 0.00 | 0.00 | 0.00 | 2542.  | 1 04   | 11 00  | 83     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 9 00   | 9      | 0.00 | 0.00   | 0.00 | 0.11   |
| 1 01               | 9 00   | 9      | 0.00 | 0.00 | 0.00 | 2892.  | 1 04   | 12 00  | 84     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 10 00  | 10     | 0.00 | 0.00   | 0.00 | 0.08   |
| 1 01               | 10 00  | 10     | 0.00 | 0.00 | 0.00 | 2934.  | 1 04   | 13 00  | 85     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 11 00  | 11     | 0.00 | 0.00   | 0.00 | 0.05   |
| 1 01               | 11 00  | 11     | 0.00 | 0.00 | 0.00 | 2781.  | 1 04   | 14 00  | 86     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 12 00  | 12     | 0.00 | 0.00   | 0.00 | 0.02   |
| 1 01               | 12 00  | 12     | 0.00 | 0.00 | 0.00 | 2596.  | 1 04   | 15 00  | 87     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 13 00  | 13     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 01               | 13 00  | 13     | 0.00 | 0.00 | 0.00 | 2417.  | 1 04   | 16 00  | 88     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 14 00  | 14     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 01               | 14 00  | 14     | 0.00 | 0.00 | 0.00 | 2250.  | 1 04   | 17 00  | 89     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 15 00  | 15     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 01               | 15 00  | 15     | 0.00 | 0.00 | 0.00 | 2095.  | 1 04   | 18 00  | 90     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 16 00  | 16     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 01               | 16 00  | 16     | 0.00 | 0.00 | 0.00 | 1950.  | 1 04   | 19 00  | 91     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 17 00  | 17     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 01               | 17 00  | 17     | 0.00 | 0.00 | 0.00 | 1816.  | 1 04   | 20 00  | 92     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 18 00  | 18     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 01               | 18 00  | 18     | 0.00 | 0.00 | 0.00 | 1691.  | 1 04   | 21 00  | 93     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 19 00  | 19     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 01               | 19 00  | 19     | 0.00 | 0.00 | 0.00 | 1574.  | 1 04   | 22 00  | 94     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 20 00  | 20     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 01               | 20 00  | 20     | 0.00 | 0.00 | 0.00 | 1465.  | 1 04   | 23 00  | 95     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 21 00  | 21     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 01               | 21 00  | 21     | 0.00 | 0.00 | 0.00 | 1364.  | 1 05   | 0 00   | 96     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 22 00  | 22     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 01               | 22 00  | 22     | 0.00 | 0.00 | 0.00 | 1270.  | 1 05   | 1 00   | 97     | 0.00   | 0.00 | 0.00 | 0.00   | 1 01   | 23 00  | 23     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 01               | 23 00  | 23     | 0.00 | 0.00 | 0.00 | 1183.  | 1 05   | 2 00   | 98     | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 0 00   | 24     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 0 00   | 24     | 0.00 | 0.00 | 0.00 | 1101.  | 1 05   | 3 00   | 99     | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 1 00   | 25     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 1 00   | 25     | 0.00 | 0.00 | 0.00 | 1025.  | 1 05   | 4 00   | 100    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 2 00   | 26     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 2 00   | 26     | 0.00 | 0.00 | 0.00 | 954.   | 1 05   | 5 00   | 101    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 3 00   | 27     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 3 00   | 27     | 0.00 | 0.00 | 0.00 | 889.   | 1 05   | 6 00   | 102    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 4 00   | 28     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 4 00   | 28     | 0.00 | 0.00 | 0.00 | 827.   | 1 05   | 7 00   | 103    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 5 00   | 29     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 5 00   | 29     | 0.00 | 0.00 | 0.00 | 770.   | 1 05   | 8 00   | 104    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 6 00   | 30     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 6 00   | 30     | 0.00 | 0.00 | 0.00 | 717.   | 1 05   | 9 00   | 105    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 7 00   | 31     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 7 00   | 31     | 0.00 | 0.00 | 0.00 | 668.   | 1 05   | 10 00  | 106    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 8 00   | 32     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 8 00   | 32     | 0.00 | 0.00 | 0.00 | 622.   | 1 05   | 11 00  | 107    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 9 00   | 33     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 9 00   | 33     | 0.00 | 0.00 | 0.00 | 579.   | 1 05   | 12 00  | 108    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 10 00  | 34     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 10 00  | 34     | 0.00 | 0.00 | 0.00 | 539.   | 1 05   | 13 00  | 109    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 11 00  | 35     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 11 00  | 35     | 0.00 | 0.00 | 0.00 | 502.   | 1 05   | 14 00  | 110    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 12 00  | 36     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 12 00  | 36     | 0.00 | 0.00 | 0.00 | 467.   | 1 05   | 15 00  | 111    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 13 00  | 37     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 13 00  | 37     | 0.00 | 0.00 | 0.00 | 435.   | 1 05   | 16 00  | 112    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 14 00  | 38     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 14 00  | 38     | 0.00 | 0.00 | 0.00 | 405.   | 1 05   | 17 00  | 113    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 15 00  | 39     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 15 00  | 39     | 0.00 | 0.00 | 0.00 | 377.   | 1 05   | 18 00  | 114    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 16 00  | 40     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 16 00  | 40     | 0.00 | 0.00 | 0.00 | 351.   | 1 05   | 19 00  | 115    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 17 00  | 41     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 17 00  | 41     | 0.00 | 0.00 | 0.00 | 327.   | 1 05   | 20 00  | 116    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 18 00  | 42     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 18 00  | 42     | 0.00 | 0.00 | 0.00 | 304.   | 1 05   | 21 00  | 117    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 19 00  | 43     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 19 00  | 43     | 0.00 | 0.00 | 0.00 | 283.   | 1 05   | 22 00  | 118    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 20 00  | 44     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 20 00  | 44     | 0.00 | 0.00 | 0.00 | 264.   | 1 05   | 23 00  | 119    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 21 00  | 45     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 21 00  | 45     | 0.00 | 0.00 | 0.00 | 246.   | 1 06   | 0 00   | 120    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 22 00  | 46     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 22 00  | 46     | 0.00 | 0.00 | 0.00 | 229.   | 1 06   | 1 00   | 121    | 0.00   | 0.00 | 0.00 | 0.00   | 1 02   | 23 00  | 47     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 02               | 23 00  | 47     | 0.00 | 0.00 | 0.00 | 213.   | 1 06   | 2 00   | 122    | 0.00   | 0.00 | 0.00 | 0.00   | 1 03   | 0 00   | 48     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 03               | 0 00   | 48     | 0.00 | 0.00 | 0.00 | 198.   | 1 06   | 3 00   | 123    | 0.00   | 0.00 | 0.00 | 0.00   | 1 03   | 1 00   | 49     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 03               | 1 00   | 49     | 0.00 | 0.00 | 0.00 | 184.   | 1 06   | 4 00   | 124    | 0.00   | 0.00 | 0.00 | 0.00   | 1 03   | 2 00   | 50     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 03               | 2 00   | 50     | 0.00 | 0.00 | 0.00 | 172.   | 1 06   | 5 00   | 125    | 0.00   | 0.00 | 0.00 | 0.00   | 1 03   | 3 00   | 51     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 03               | 3 00   | 51     | 0.00 | 0.00 | 0.00 | 160.   | 1 06   | 6 00   | 126    | 0.00   | 0.00 | 0.00 | 0.00   | 1 03   | 4 00   | 52     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 03               | 4 00   | 52     | 0.00 | 0.00 | 0.00 | 149.   | 1 06   | 7 00   | 127    | 0.00   | 0.00 | 0.00 | 0.00   | 1 03   | 5 00   | 53     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 03               | 5 00   | 53     | 0.00 | 0.00 | 0.00 | 139.   | 1 06   | 8 00   | 128    | 0.00   | 0.00 | 0.00 | 0.00   | 1 03   | 6 00   | 54     | 0.00 | 0.00   | 0.00 | 0.00   |
| 1 03               | 6 00   | 54     | 0.00 | 0.00 | 0.00 | 129.   | 1 06   | 9 00   | 129    | 0.00   | 0.00 | 0.00 | 0.00   |        |        |        |      |        |      |        |

BY:        DATE:         
CHKD. BY:        DATE:         
SUBJECT:       

# LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 412 OF 615  
PROJECT:       

|                           |       |    |      |      |      |      |      |      |      |      |       |     |      |      |      |      |
|---------------------------|-------|----|------|------|------|------|------|------|------|------|-------|-----|------|------|------|------|
| 1.03                      | 7.00  | 55 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 120. | 1.06 | 10.00 | 130 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 8.00  | 56 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 112  | 1.06 | 11.00 | 131 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 9.00  | 57 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 104  | 1.06 | 12.00 | 132 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 10.00 | 58 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 97   | 1.06 | 13.00 | 133 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 11.00 | 59 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 90   | 1.06 | 14.00 | 134 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 12.00 | 60 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 84   | 1.06 | 15.00 | 135 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 13.00 | 61 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 78   | 1.06 | 16.00 | 136 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 14.00 | 62 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 73   | 1.06 | 17.00 | 137 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 15.00 | 63 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 68   | 1.06 | 18.00 | 138 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 16.00 | 64 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 63   | 1.06 | 19.00 | 139 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 17.00 | 65 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 59   | 1.06 | 20.00 | 140 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 18.00 | 66 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 55   | 1.06 | 21.00 | 141 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 19.00 | 67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 51   | 1.06 | 22.00 | 142 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 20.00 | 68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 47   | 1.06 | 23.00 | 143 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 21.00 | 69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 44   | 1.07 | 0.00  | 144 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 22.00 | 70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 41   | 1.07 | 1.00  | 145 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.03                      | 23.00 | 71 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 38   | 1.07 | 2.00  | 146 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.04                      | 0.00  | 72 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 36   | 1.07 | 3.00  | 147 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.04                      | 1.00  | 73 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 33   | 1.07 | 4.00  | 148 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.04                      | 2.00  | 74 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 31   | 1.07 | 5.00  | 149 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1.04                      | 3.00  | 75 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 29   | 1.07 | 6.00  | 150 | 0.00 | 0.00 | 0.00 | 0.00 |
| SUM 5.20 4.28 0.92 52524. |       |    |      |      |      |      |      |      |      |      |       |     |      |      |      |      |
| (132.)(107.)(23.)(1487.31 |       |    |      |      |      |      |      |      |      |      |       |     |      |      |      |      |

## ROUTED FLOWS THROUGH RESERVOIR

| ISTAG        | ICOMP | IECON | ITAPE | JPLT  | JPRT | INAME | ISTAGE | IAUTO |
|--------------|-------|-------|-------|-------|------|-------|--------|-------|
| 2            | 1     | 0     | 0     | 0     | 0    | 1     | 0      | 0     |
| ROUTING DATA |       |       |       |       |      |       |        |       |
| QLOSS        | CLOSS | AVG   | IRCS  | ISAME | IOPT | IPMP  | LSTR   |       |
| 0.0          | 0.000 | 0.00  | 1     | 0     | 0    | 0     | 0      |       |

|               |       |        |        |        |         |         |         |         |         |
|---------------|-------|--------|--------|--------|---------|---------|---------|---------|---------|
| STAGE         | 11.80 | 13.80  | 15.80  | 17.80  | 19.80   | 20.80   | 21.80   | 23.80   | 25.80   |
| FLOW          | 0.00  | 175.00 | 481.00 | 843.00 | 1278.00 | 1450.00 | 1764.00 | 3623.00 | 7399.00 |
| SURFACE AREA= | 18.   | 28.    | 74     | 102.   | 186.    |         |         |         |         |
| CAPACITY=     | 0     | 140    | 237    | 455.   | 1516.   |         |         |         |         |
| ELEVATION=    | 12    | 18.    | 20.    | 23.    | 30.     |         |         |         |         |

|      |       |      |      |      |      |       |      |
|------|-------|------|------|------|------|-------|------|
| CREL | SPWID | COQW | EXPW | ELEV | COQL | CAREA | EXPL |
| 11.9 | 0.0   | 0.0  | 0.0  | 0.0  | 0.0  | 0.0   | 0.0  |

|          |      |      |        |
|----------|------|------|--------|
| DAM DATA |      |      |        |
| TOPEL    | COGD | EXPD | DAMWID |
| 21.8     | 0.0  | 0.0  | 0.     |

| END-OF-PERIOD HYDROGRAPH ORDINATES |        |        |       |       |
|------------------------------------|--------|--------|-------|-------|
| MO. DA                             | HR. MN | PERIOD | HOURS | STAGE |
| 1.01                               | 1.00   | 1      | 1.00  | 0.    |
| 1.01                               | 2.00   | 2      | 2.00  | 0.    |
| 1.01                               | 3.00   | 3      | 3.00  | 0.    |

BY LC DATE 4/1/71

## LOUIS BERGER &amp; ASSOCIATES INC.

SHEET NO. 413 OF 415

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

PROJECT C 24

SUBJECT \_\_\_\_\_

|      |       |    |       |       |       |      |      |
|------|-------|----|-------|-------|-------|------|------|
| 1.01 | 3.00  | 3  | 3.00  | 17.   | 3.    | 1.   | 11.8 |
| 1.01 | 4.00  | 4  | 4.00  | 179.  | 35.   | 7.   | 12.2 |
| 1.01 | 5.00  | 5  | 5.00  | 605.  | 147.  | 32.  | 13.5 |
| 1.01 | 6.00  | 6  | 6.00  | 1240. | 475.  | 83.  | 15.8 |
| 1.01 | 7.00  | 7  | 7.00  | 1945. | 983.  | 154. | 18.4 |
| 1.01 | 8.00  | 8  | 8.00  | 2542. | 1328. | 244. | 20.1 |
| 1.01 | 9.00  | 9  | 9.00  | 2892. | 1624. | 347. | 21.4 |
| 1.01 | 10.00 | 10 | 10.00 | 2934. | 2181. | 430. | 22.2 |
| 1.01 | 11.00 | 11 | 11.00 | 2781. | 2554. | 471. | 22.7 |
| 1.01 | 12.00 | 12 | 12.00 | 2596. | 2627. | 479. | 22.7 |
| 1.01 | 13.00 | 13 | 13.00 | 2417. | 2562. | 471. | 22.7 |
| 1.01 | 14.00 | 14 | 14.00 | 2250. | 2437. | 458. | 22.5 |
| 1.01 | 15.00 | 15 | 15.00 | 2095. | 2291. | 442. | 22.4 |
| 1.01 | 16.00 | 16 | 16.00 | 1950. | 2141. | 426. | 22.2 |
| 1.01 | 17.00 | 17 | 17.00 | 1816. | 1995. | 410. | 22.0 |
| 1.01 | 18.00 | 18 | 18.00 | 1691. | 1856. | 396. | 21.9 |
| 1.01 | 19.00 | 19 | 19.00 | 1574. | 1748. | 382. | 21.7 |
| 1.01 | 20.00 | 20 | 20.00 | 1465. | 1691. | 366. | 21.6 |
| 1.01 | 21.00 | 21 | 21.00 | 1364. | 1621. | 346. | 21.3 |
| 1.01 | 22.00 | 22 | 22.00 | 1270. | 1542. | 324. | 21.1 |
| 1.01 | 23.00 | 23 | 23.00 | 1183. | 1457. | 301. | 20.8 |
| 1.02 | 0.00  | 24 | 24.00 | 1101. | 1403. | 278. | 20.5 |
| 1.02 | 1.00  | 25 | 25.00 | 1025. | 1346. | 252. | 20.2 |
| 1.02 | 2.00  | 26 | 26.00 | 954.  | 1283. | 225. | 19.8 |
| 1.02 | 3.00  | 27 | 27.00 | 889.  | 1194. | 199. | 19.4 |
| 1.02 | 4.00  | 28 | 28.00 | 827.  | 1095. | 175. | 19.0 |
| 1.02 | 5.00  | 29 | 29.00 | 770.  | 989.  | 155. | 18.5 |
| 1.02 | 6.00  | 30 | 30.00 | 717.  | 881.  | 139. | 18.0 |
| 1.02 | 7.00  | 31 | 31.00 | 668.  | 794.  | 127. | 17.5 |
| 1.02 | 8.00  | 32 | 32.00 | 622.  | 728.  | 118. | 17.2 |
| 1.02 | 9.00  | 33 | 33.00 | 579.  | 671.  | 109. | 16.8 |
| 1.02 | 10.00 | 34 | 34.00 | 539.  | 620.  | 102. | 16.6 |
| 1.02 | 11.00 | 35 | 35.00 | 502.  | 574.  | 96.  | 16.3 |
| 1.02 | 12.00 | 36 | 36.00 | 467.  | 532.  | 90.  | 16.1 |
| 1.02 | 13.00 | 37 | 37.00 | 435.  | 494.  | 85.  | 15.9 |
| 1.02 | 14.00 | 38 | 38.00 | 405.  | 461.  | 80.  | 15.7 |
| 1.02 | 15.00 | 39 | 39.00 | 377.  | 431.  | 76.  | 15.5 |
| 1.02 | 16.00 | 40 | 40.00 | 351.  | 403.  | 71.  | 15.3 |
| 1.02 | 17.00 | 41 | 41.00 | 327.  | 375.  | 67.  | 15.1 |
| 1.02 | 18.00 | 42 | 42.00 | 304.  | 349.  | 64.  | 14.9 |
| 1.02 | 19.00 | 43 | 43.00 | 283.  | 325.  | 60.  | 14.8 |
| 1.02 | 20.00 | 44 | 44.00 | 264.  | 302.  | 57.  | 14.6 |
| 1.02 | 21.00 | 45 | 45.00 | 246.  | 281.  | 54.  | 14.5 |
| 1.02 | 22.00 | 46 | 46.00 | 229.  | 261.  | 51.  | 14.4 |
| 1.02 | 23.00 | 47 | 47.00 | 213.  | 243.  | 48.  | 14.2 |
| 1.03 | 0.00  | 48 | 48.00 | 198.  | 226.  | 46.  | 14.1 |
| 1.03 | 1.00  | 49 | 49.00 | 184.  | 210.  | 44.  | 14.0 |
| 1.03 | 2.00  | 50 | 50.00 | 172.  | 195.  | 42.  | 13.9 |
| 1.03 | 3.00  | 51 | 51.00 | 160.  | 182.  | 40.  | 13.8 |
| 1.03 | 4.00  | 52 | 52.00 | 149.  | 171.  | 38.  | 13.8 |
| 1.03 | 5.00  | 53 | 53.00 | 139.  | 163.  | 36.  | 13.7 |
| 1.03 | 6.00  | 54 | 54.00 | 129.  | 154.  | 34.  | 13.6 |
| 1.03 | 7.00  | 55 | 55.00 | 120.  | 145.  | 32.  | 13.5 |
| 1.03 | 8.00  | 56 | 56.00 | 112.  | 136.  | 30.  | 13.4 |
| 1.03 | 9.00  | 57 | 57.00 | 104.  | 128.  | 28.  | 13.3 |
| 1.03 | 10.00 | 58 | 58.00 | 97.   | 119.  | 26.  | 13.2 |
| 1.03 | 11.00 | 59 | 59.00 | 90.   | 112.  | 24.  | 13.1 |
| 1.03 | 12.00 | 60 | 60.00 | 84.   | 104.  | 22.  | 13.0 |
| 1.03 | 13.00 | 61 | 61.00 | 78.   | 97.   | 21.  | 12.9 |
| 1.03 | 14.00 | 62 | 62.00 | 73.   | 90.   | 19.  | 12.8 |
| 1.03 | 15.00 | 63 | 63.00 | 68.   | 84.   | 18.  | 12.8 |
| 1.03 | 16.00 | 64 | 64.00 | 63.   | 78.   | 17.  | 12.7 |
| 1.03 | 17.00 | 65 | 65.00 | 59.   | 73.   | 15.  | 12.6 |
| 1.03 | 18.00 | 66 | 66.00 | 55.   | 68.   | 14.  | 12.6 |
| 1.03 | 19.00 | 67 | 67.00 | 51.   | 63.   | 13.  | 12.5 |
| 1.03 | 20.00 | 68 | 68.00 | 47.   | 59.   | 12.  | 12.5 |
| 1.03 | 21.00 | 69 | 69.00 | 44.   | 54.   | 11.  | 12.4 |
| 1.03 | 22.00 | 70 | 70.00 | 41.   | 51.   | 11.  | 12.4 |
| 1.03 | 23.00 | 71 | 71.00 | 38.   | 47.   | 10.  | 12.3 |
| 1.04 | 0.00  | 72 | 72.00 | 36.   | 44.   | 9.   | 12.3 |
| 1.04 | 1.00  | 73 | 73.00 | 33.   | 41.   | 9.   | 12.3 |
| 1.04 | 2.00  | 74 | 74.00 | 31.   | 38.   | 8.   | 12.2 |
| 1.04 | 3.00  | 75 | 75.00 | 29.   | 35.   | 7.   | 12.2 |
| 1.04 | 4.00  | 76 | 76.00 | 27.   | 33.   | 7.   | 12.2 |
| 1.04 | 5.00  | 77 | 77.00 | 25.   | 31.   | 6.   | 12.1 |
| 1.04 | 6.00  | 78 | 78.00 | 23.   | 28.   | 6.   | 12.1 |
| 1.04 | 7.00  | 79 | 79.00 | 22.   | 26.   | 6.   | 12.1 |
| 1.04 | 8.00  | 80 | 80.00 | 20.   | 25.   | 5.   | 12.1 |

BY SC DATE 4/1/77  
 CHKD. BY DATE  
 SUBJECT HEC-1

# LOUIS BERGER & ASSOCIATES INC.

SHEET NO A-17 OF 17  
 PROJECT C-2

|      |       |     |        |     |     |    |      |
|------|-------|-----|--------|-----|-----|----|------|
| 1.04 | 9.00  | 81  | 81.00  | 17. | 23. | 5. | 12.1 |
| 1.04 | 10.00 | 82  | 82.00  | 4.  | 19. | 4. | 12.0 |
| 1.04 | 11.00 | 83  | 83.00  | 1.  | 13. | 3. | 12.0 |
| 1.04 | 12.00 | 84  | 84.00  | 0.  | 9.  | 2. | 11.9 |
| 1.04 | 13.00 | 85  | 85.00  | 0.  | 6.  | 1. | 11.9 |
| 1.04 | 14.00 | 86  | 86.00  | 0.  | 4.  | 1. | 11.8 |
| 1.04 | 15.00 | 87  | 87.00  | 0.  | 3.  | 1. | 11.8 |
| 1.04 | 16.00 | 88  | 88.00  | 0.  | 2.  | 0. | 11.8 |
| 1.04 | 17.00 | 89  | 89.00  | 0.  | 1.  | 0. | 11.8 |
| 1.04 | 18.00 | 90  | 90.00  | 0.  | 1.  | 0. | 11.8 |
| 1.04 | 19.00 | 91  | 91.00  | 0.  | 1.  | 0. | 11.8 |
| 1.04 | 20.00 | 92  | 92.00  | 0.  | 0.  | 0. | 11.8 |
| 1.04 | 21.00 | 93  | 93.00  | 0.  | 0.  | 0. | 11.8 |
| 1.04 | 22.00 | 94  | 94.00  | 0.  | 0.  | 0. | 11.8 |
| 1.04 | 23.00 | 95  | 95.00  | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 0.00  | 96  | 96.00  | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 1.00  | 97  | 97.00  | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 2.00  | 98  | 98.00  | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 3.00  | 99  | 99.00  | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 4.00  | 100 | 100.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 5.00  | 101 | 101.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 6.00  | 102 | 102.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 7.00  | 103 | 103.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 8.00  | 104 | 104.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 9.00  | 105 | 105.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 10.00 | 106 | 106.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 11.00 | 107 | 107.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 12.00 | 108 | 108.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 13.00 | 109 | 109.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 14.00 | 110 | 110.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 15.00 | 111 | 111.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 16.00 | 112 | 112.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 17.00 | 113 | 113.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 18.00 | 114 | 114.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 19.00 | 115 | 115.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 20.00 | 116 | 116.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 21.00 | 117 | 117.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 22.00 | 118 | 118.00 | 0.  | 0.  | 0. | 11.8 |
| 1.05 | 23.00 | 119 | 119.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 0.00  | 120 | 120.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 1.00  | 121 | 121.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 2.00  | 122 | 122.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 3.00  | 123 | 123.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 4.00  | 124 | 124.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 5.00  | 125 | 125.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 6.00  | 126 | 126.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 7.00  | 127 | 127.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 8.00  | 128 | 128.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 9.00  | 129 | 129.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 10.00 | 130 | 130.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 11.00 | 131 | 131.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 12.00 | 132 | 132.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 13.00 | 133 | 133.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 14.00 | 134 | 134.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 15.00 | 135 | 135.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 16.00 | 136 | 136.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 17.00 | 137 | 137.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 18.00 | 138 | 138.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 19.00 | 139 | 139.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 20.00 | 140 | 140.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 21.00 | 141 | 141.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 22.00 | 142 | 142.00 | 0.  | 0.  | 0. | 11.8 |
| 1.06 | 23.00 | 143 | 143.00 | 0.  | 0.  | 0. | 11.8 |
| 1.07 | 0.00  | 144 | 144.00 | 0.  | 0.  | 0. | 11.8 |
| 1.07 | 1.00  | 145 | 145.00 | 0.  | 0.  | 0. | 11.8 |
| 1.07 | 2.00  | 146 | 146.00 | 0.  | 0.  | 0. | 11.8 |
| 1.07 | 3.00  | 147 | 147.00 | 0.  | 0.  | 0. | 11.8 |
| 1.07 | 4.00  | 148 | 148.00 | 0.  | 0.  | 0. | 11.8 |
| 1.07 | 5.00  | 149 | 149.00 | 0.  | 0.  | 0. | 11.8 |
| 1.07 | 6.00  | 150 | 150.00 | 0.  | 0.  | 0. | 11.8 |

PEAK OUTFLOW IS

2627. AT TIME 12.00 HOURS

|            |      |       |       |        |        |
|------------|------|-------|-------|--------|--------|
| CFS        | 2627 | 2439  | 1697  | 726    | 52526  |
| CMS        | 74   | 69    | 48    | 21     | 1487   |
| INCHES     |      | 1.19  | 3.31  | 4.25   | 4.26   |
| MM         |      | 30.17 | 83.99 | 107.82 | 108.30 |
| AC-FT      |      | 1209  | 3367  | 4322   | 4341   |
| THOUS CU M |      | 1492  | 4153  | 5331   | 5355   |



BY MLC DATE 4/1  
 CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
 SUBJECT 1150-10

# LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 1-15 OF 15  
 PROJECT 5-1-1

## RUNOFF SUMMARY, AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)

|               |   | AREA IN SQUARE MILES (SQUARE KILOMETERS) |           |           |           |           |
|---------------|---|--|-----------|-----------|-----------|-----------|
| HYDROGRAPH AT | 1 | 2934                                     | 2669      | 1729      | 727       | 19.10     |
|               |   | ( 83.07 )                                | ( 75.59 ) | ( 48.95 ) | ( 20.59 ) | ( 49.47 ) |
| ROUTED TO     | 2 | 2627                                     | 2439      | 1697      | 726       | 19.10     |
|               |   | ( 74.39 )                                | ( 69.06 ) | ( 48.06 ) | ( 20.57 ) | ( 49.47 ) |

## SUMMARY OF DAM SAFETY ANALYSIS

|           | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|-----------|---------------|----------------|------------|
| ELEVATION | 11.80         | 11.80          | 21.80      |
| STORAGE   | 0.            | 0.             | 387.       |
| OUTFLOW   | 0.            | 0.             | 1764.      |

| RATIO OF PMF | MAXIMUM RESERVOIR W. S. ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|--------------|------------------------------|------------------------|-----------------------|---------------------|-------------------------|---------------------------|-----------------------|
| 0.00         | 22.73                        | 0.93                   | 479.                  | 2627.               | 9.00                    | 12.00                     | 0.00                  |

# Lake Rampant In Blackwood

A grim picture of rising water and flooded homes unfolded in South Jersey today, centering around the Blackwood Lake area where as many as 20 families were reported to have been evacuated by cautious Gloucester Township officials.

With water levels rising as high as 12 to 15 feet above normal a number of roads were reported submerged or washed out, major telephone service disruptions and Gloucester Township police declared a state of emergency. No injuries were reported.

Mrs. Elmer Zuber of 302 West Lake Avenue, Blackwood, reported that she and her family including a three-year-old son were forced to leave their home about 4 a.m. "for the second time this week."

## Cellar Flooded

Mrs. Zuber said the water from Blackwood Lake was three to four feet deep in the cellar of their home which sits at the lake's edge.

In the same area a Blackwood fire department spokesman said the lake's dams were holding but expressed concern for rising water levels in nearby Bell, Cedar and Lakeside Lakes.

"If one of these lakes' dams go this whole area will go," he said.

## Above Normal

He added, "The water around here is close to 10 feet above normal. Woodbury Road-Blackwood Road is completely washed out or under water and a number of families have already been moved."

Patrol police reported general flooding conditions in their area including Deeds Drive and Holly Avenue but no accidents or injuries resulting from the excessive water.

In Gloucester Township, a reported 8 to 10 feet of water completely submerged the area around the Blackwood Lake area.

## 20 Families Evacuated By Area Flood Waters

Continued From Page One

area "on the verge of going out."

### Normal in Camden

Also flooded were Almonesson Road and Cherry Landing-Somerdale Road in the Deptford and Gloucester Townships.

In Camden the situation was relatively normal with no service disruptions reported by public service utilities and the Pennsylvania-Reading Seashore Lines reported trains on schedule but carrying more passengers than normal.

Mount Holly police said Rancocas Creek was above normal with potential flooding "if the rain continues."

### Clearing Due Today

The U.S. Weather Bureau at Philadelphia International Airport measured 2.04 inches rainfall last night but predicted clearing skies late this afternoon.

The forecaster said the extensive rain resulted from "a cold front stretching from upstate New York through Allentown, Pa. to Washington, D.C."

"It's generally moving eastward and should break-up this afternoon with a beautiful day in store tomorrow."

### Above Normal

The sharp increase in rainfall brought the month's total to 5.77 inches, more than four inches above normal for the nine-day period. The year's total of 30.18 inches is 3.5 inches above normal.

Leslie A. Miller, senior Camden County agricultural agent, said rain gauges in the area measured as much as five inches of rain since about 9 p.m. last night with the Berlin-Clementon area taking the brunt of the rainfall.

He said, "That area (Berlin-Clementon) measured 4.5 to 5 inches in 12 hours."

Other measurements he reported were Cherry Hill 2.5 inches; Camden 2.5 inches; Cedar Brook 3.5 inches; Hammonton 2.5 inches.

### Side Effect

A side effect of the heavy rain, he said, will be excessive dam-

age to the area's projected to ward and should break-up this afternoon with a beautiful day in store tomorrow."

In the Blackwood Lake area Joseph Sanders, deputy director of the Camden County Civil Defense Group, said the flooding was "the worst in the area since 1940."

He added that rising water had ruined stocks and supplies in the basements of the Lakeside campus of hospital buildings but there was no apparent threat to the safety of the persons confined there.

Homeowners evacuated from the Blackwood Lake shore are being fed at the local firehouse and beds will be available if necessary, he said.

# as flood waters subside



Gloucester Township firemen pull timbers from swollen Blackwood Lake which overflowed after heavy rains

Civil Defense authorities said the threat of a dam burst at Blackwood Lake passed yesterday as flood water started to subside.

Joseph Sandone, deputy Civil Defense director in Camden County, said that Blackwood Lake Dam has burst, the surging flood waters would have threatened the homes of some 2,000 persons who live along the lake and along Big Timber Creek towards Westville six miles away on the Delaware River near Camden.

Sandone said the 2,000 persons were evacuated to the homes of friends and relatives while about 400 police, firemen and rescue squads worked to keep the dam intact.

## SERIOUS DANGER

He said the dam was in serious danger of giving away for several hours as waters from Wednesday night's

rain burst a roadway, the dam also carries a main cable for New Jersey Bell Telephone Co., gas mains from South Jersey Gas Co., and a power line from Public Service Gas & Electric Co., Sandone reported.

He explained that Blackwood Lake is small but numerous streams feed into it. The Little and Big Timber Creek separate Camden and Gloucester Counties.

Although the dam was sturdily built, Sandone said, it probably suffered thousands of dollars of damage and will need new floodgates. He said there is already talk of expanding it

from its present 100-foot width to 120 feet.

He described the crisis as "the worst here since the 1914 flood" which hit large portions of Southern New Jersey.

dam and undermined the dam itself. However, the water

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The Evening Bulletin - 8/17/67

## County, Township Funds Asked

# New Spillway and Flood Gates Are Sought for Blackwood Lake

By FREDERICK BOYLE  
Of The Bulletin Staff

Blackwood—Three local residents are taking steps they hope will prevent further flooding of the area around Blackwood Lake.

They plan to arrange meetings with Gloucester and Washington Township committees and freeholders of Camden and Gloucester counties. They hope these governing bodies can finance construction of a new spillway and flood gates for the lake.

Torrential rains a week ago forced many families around the lake to leave their homes because of the flood.

Charles Thompson, of 1 Wildcon lane, said he thinks the 20-year-old gates and spillway should be replaced.

Thompson, with Bernard Betts and Joseph Hamilton, expects to appoint a six to nine-member committee within a few weeks to present the lake situation to governing bodies concerned.

Blackwood Lake is on the boundary of Gloucester Township in Camden County and Washington Township in Gloucester County. The dam where the spillway and flood gates are located separates the lake from Big Timber Creek.

The three men are officers of Lake Site Corp., a private corporation which controls an area of the lake where fishing is permitted.

The men also are interested in revitalizing the Blackwood Lake Improvement Association and recruiting new members for it. The hope is that the organization would back efforts to have new gates and a spillway built.

The association has been dormant for a couple of years, Thompson said. But some four years ago it had about 230 members.

There are some 400 or 500 people living in and around the lake who might be interested in joining the association now, according to Thompson.

Charter for the organization dates from 1916 when the association was established for welfare of the lake-area people for area protection and to encourage water sports on the lake. Thompson said he expects volunteers next week will be

able to survey all homes that front on the lake and others that would be in danger of flooding. An attempt will be made to estimate the amount of damage caused by the Aug. 10 flood.

The original dam and spillway were built in 1922 and financed by the two townships and two counties involved, Thompson said.

A flood in 1940 spurred efforts of residents then to get new gates built but it took several years to accomplish this mission. At that time, the Blackwood-Woodbury roadbed was washed out. There was four feet of water in the Thompson house in 1940 as compared with four inches last week. The present gates are the ones installed in 1947.

Thompson said he has examined the tax records and found that no one pays taxes on the lake properties. From that he assumes that the lake is jointly owned by Washington and Gloucester townships. Residents whose homes front on the lakes own their properties up to the water line, Thompson said.

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